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Electrical World

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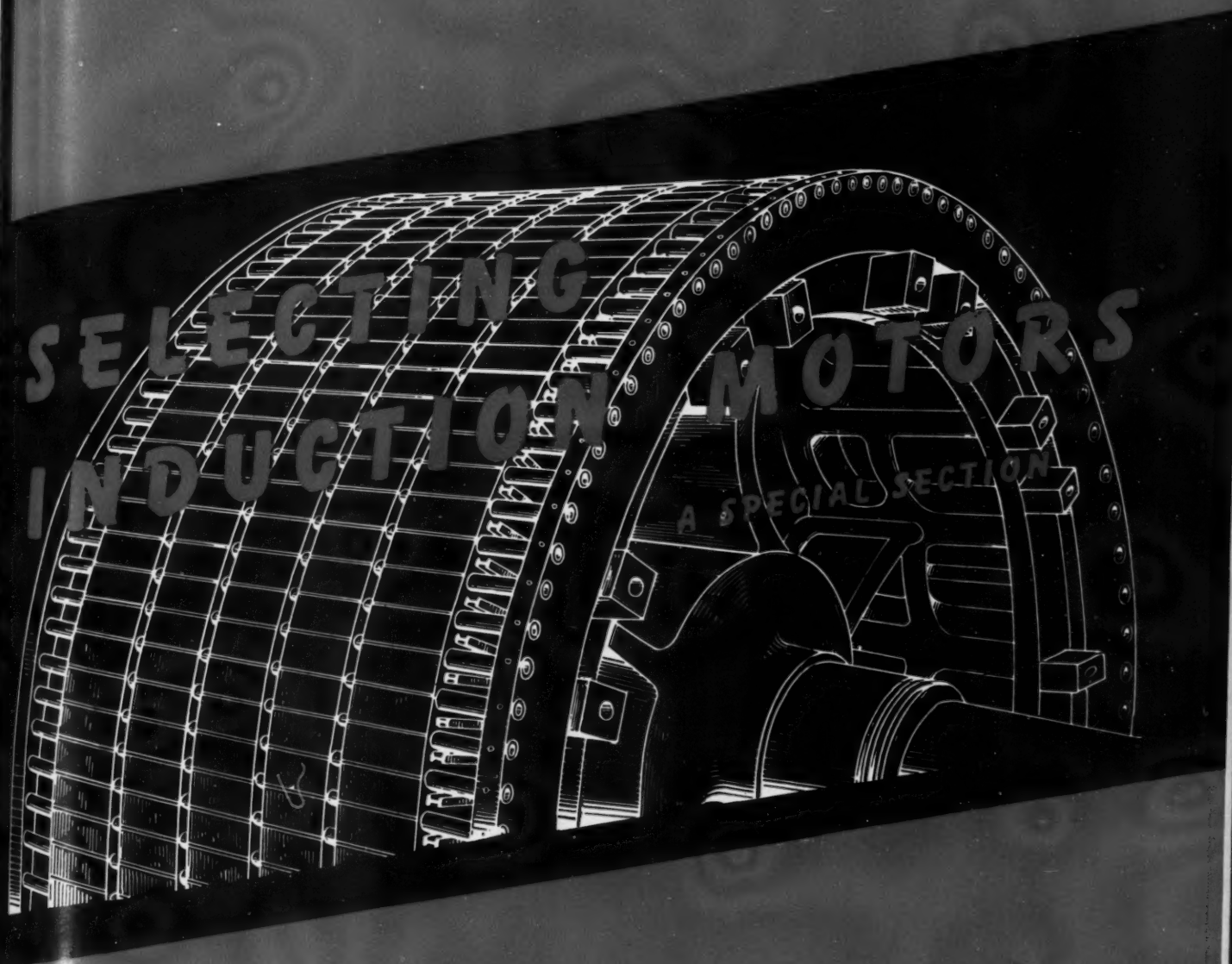

MARCH 29, 1947

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Electrical World

MARCH 29, 1947

Will Power Policy Change?

DURING the Democratic party's control of the federal government, the nation's power policy has become increasingly painful to most of those who operate its electric power industry.

As public ownership and government control penetrated deeper, it was only natural that those who disliked it should ponder their possibilities when political control should be removed from the New Deal-Democratic party. Although the vigor of the drive diminished, no retrogression was possible without political change.

With last fall's staggering Republican victory came the first possibility in 16 years that federal power policy might be redirected. Possibilities for changing federal power policy were numerous. Federal preemption of water power sites might be modified. Private capital might be permitted to participate in water-control projects. Federal transmission, or off-site marketing, might stop. Possibilities of federal steam-electric plant construction might be scotched. The preferential sales policy might be terminated. The tax inequity might be removed and the ridiculous "yardstick" theory finally demonstrated the fraud that it is under existing tax policies. Equality of regulation between ownership might be achieved. Congress has had opportunities to act on many of these issues in recent years. Diligently, it has avoided them.

Presently, it appears that the most likely revision of federal power policy this year will not be one of these at all—that if any be achieved, it will be founded upon whatever changes the G.O.P. makes in U. S. fiscal policy.

Clearly, it is time to balance the national budget. Last November made it inescapable that most voters also want taxes reduced. Less specifically, perhaps, but quite plainly, the electorate demanded debt reduction. If the 80th Congress heeds these fiscal admonitions, it will affect U. S. power policy substantially.

Specifically, balancing the budget will end deficit spending, a foundation stone of federal power programs. Specifically, any money spent in debt reduction will be unavailable for power projects, as will be funds not collected because of tax reductions. Not singly, but in unison, these three fiscal policies can terminate extension of the federal power interests.

Were Congress to determine that certain water control projects are more pressing even than economy, it might logically explore cost-cutting possibilities in such programs. Such exploration would lead immediately to the industry's offers to install power plants and transmission lines—under regulation—and to pay full benefits.

Were Congress to decide that fiscal policy requires the maximum return from all taxes which be retained, it might logically explore the possibilities of closing existing loopholes. This also would lead immediately to the situation whereunder users of government power not only escape taxes on it, but also receive it through the expenditure of tax revenues.

Such moves would be resisted, not because they are financially unsound, but because they would cripple if not destroy an ideology to which the administration is committed. Thus, the decision is whether the nation can support this ideological luxury.

★ ★ NEWS OF THE

Bill to Found Federal Power Policy Introduced in Senate

Senator Thomas Proposes Marketing of Federal Energy Be Transferred from Interior Department to FPC—Existing Contracts Exempted—Congress Would Have Greater Control

CONGRESSIONAL and federal agency opposition to the "Federal Power Policy" bill introduced recently by Sen. Elmer Thomas, Oklahoma Democrat, apparently was mounting this week.

Several Western Senators and Congressmen expressed concern over the possibility that the measure, which would transfer the marketing of federal energy from the Interior Department to the Federal Power Commission, might hamper current operations of the Bonneville Power Administration and the Boulder Dam project. Interior Department officials, as expected, were openly hostile to the proposal. Only FPC comment available was to the effect that the Commission would require a "considerably larger staff" than it has at present to administer such legislation.

Senator Thomas termed his bill (S. 972) a guarantee that "the public interest will be served and at the same time the consumers will secure (federal) electric energy and services at the lowest possible rates consistent with sound business principles and efficient management."

The bill would repeal Section 5 of the Flood Control Act of 1944, the provision which set up Interior as the marketing agency for hydroelectric energy produced at projects constructed by the Army Engineers. All other statutes, except the Tennessee Valley Authority Act, also would be amended as to provisions for distribution of power from government-owned plants.

However, one section of the measure exempts from change "existing contracts" made by Interior, a stipulation which Senator Thomas said would protect present agreements for sales of power from Boulder Dam, the Bonneville projects, and other established federal plants. These agreements apparently would be subject to renegotiations by FPC upon expiration, since other language of the bill calls for its application to "all federal water development projects" authorized in the past or in the future.

Other major points of the measure are:

1. Development of hydroelectric energy on all federal projects, where economically feasible, "as an incident to such public works."

2. Authorization of all such multipurpose projects by the Congress before appropriations are sought therefor. This also is one of the objectives of the Rockwell Bill (H. R. 1886), on which a House Committee has started hearings and which would deprive the Secretary of Interior of his power to authorize Reclamation projects.

3. Construction agencies, such as the Engineers and Reclamation Bureau, proposing development projects, would submit reports to Congress on their feasibility, the estimated cost of construction, the primary purpose of the project, the estimated cost of hydroelectric generating facilities, the value and marketability of power produced and the revenues to be produced by sales of energy.

4. Allocation of a definite portion of the water storage capacity of any flood control reservoir for flood control purposes, with no encroachment upon this storage reserve for power development.

FPC would be obligated to sell excess hydro power "at the damsite" or from "transmission lines owned and operated by federal agencies." The reference to federal transmission lines apparently provides only for the continued use of existing facilities owned by the government. Another section of the bill forbids federal agencies from building or acquiring any hydro plants which have power generation "as their primary purpose," and from erecting or acquiring any transmission lines except "upon specific authorization" by Congress.

FPC would observe the following priorities in sales of excess hydro energy: (1) to federally financed rural electric cooperatives, "which are engaged in rendering service to persons in rural areas . . . as restricted by the Rural Electrification Act of 1936;" (2) non-profit irrigation and water projects; (3) federal institutions not engaged in resale of power; (4) other purchasers, including private and municipal corporations.

FPC would establish wholesale rates on the basis of determinations of energy value made by the Congress in authorizing and making appropriations

Taxes on Washington P.U.D.'s Increased

Public utility districts in Washington will be taxed 5 percent of the retail sales of electricity they generate or buy from other P.U.D.'s under a new state law.

The measure now applies to only four districts, Okanogan, Grays Harbor, Clallam, and Cowlitz, but will have wide effect if the proposed purchase of the Puget Sound Power & Light Co. by the Skagit P.U.D. is consummated.

Filed at the request of the State Tax Commission and approved by the P.U.D.'s, the law is designed to protect financially certain counties and school districts which derive revenue from taxes on generating facilities of the private utility. It will give these governmental bodies the same tax revenue as previously. Under previous law, the P.U.D.'s would have had to pay only 2 percent, a rate which will continue on power purchased from private utilities or the federal government.

for each project. The commission also would set rates to establish sufficient revenues to cover power operating, maintenance and replacement costs; interest on the unpaid portion of the power investment; and a portion of the irrigation costs. All revenues collected by FPC would be returned to the Treasury.

The bill would further require FPC to keep books on each project in accordance with its own uniform system of accounts and to make a "full and complete report" annually on its power operations to Congress.

Noting a trend by federal agencies to increase their "development and distribution of electricity," Senator Thomas said he felt it was "high time" that Congress wrote a policy to govern the operations of these agencies. He would not insist that the Congress accept his bill in its entirety, he indicated.

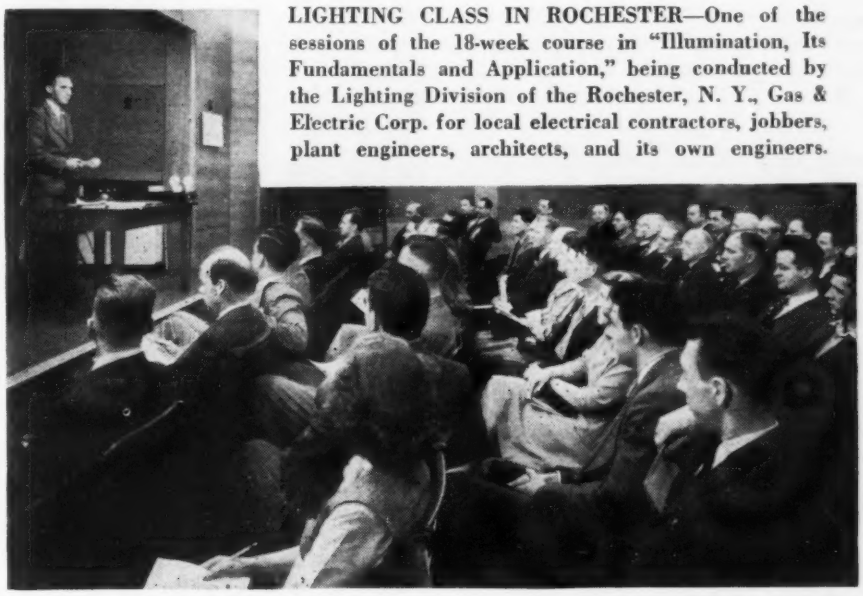
"I am more interested," he said, "in having Congress establish a definite power policy than in securing the passage of any particular bill."

35,000-Kw. Plant at Kobuta, Pa., Being Sold by WAA

War Assets Adminstration has asked for bids on a 35,000-kw. steam generating plant and auxiliary facilities in connection with its sale of a government-owned synthetic rubber plant at Kobuta, Pa. Bids on both the rubber and power plants will be accepted by WAA's Cleveland office until April 30.

To date, at least, the disposal agency has made no stipulation against separate sales of the steam station and the synthetic plant, and removal of a portion of the power facilities is expected. WAA officials indicated that the purchaser of the power equipment might be permitted a free hand in its final disposition if provision were made for the power requirements of one of the rubber plants, which was sold some months ago and has resumed operation.

Power equipment at the site includes a turbo-generator, four water tube boilers, and three 10,000-kva. transformers located at an adjacent substation. These facilities were connected at the substation with the Duquesne Light Co.'s transmission lines.



LIGHTING CLASS IN ROCHESTER—One of the sessions of the 18-week course in "Illumination, Its Fundamentals and Application," being conducted by the Lighting Division of the Rochester, N. Y., Gas & Electric Corp. for local electrical contractors, jobbers, plant engineers, architects, and its own engineers.

Wiring Devices Makers to Get 90,000 Tons of Steel

Approximately 30,000 tons of steel will be channeled into production of electrical outlets, switch boxes and fittings during each of the last three quarters of 1947. About the same amount of steel was allocated by the Civilian Production Administration for electrical wiring devices during the same periods of 1946, but this year's allocations have been set by voluntary agreements.

Needs of the industry were disclosed at a recent conference of wiring device manufacturers and CPA officials in Washington. CPA estimated 1947 requirements at 161,000,000 outlet, switch, and receptacle boxes, and 207,000,000 box and Romex box connectors. These figures do not include estimated deficits in 1946 of 24,000,000 boxes and 49,000,000 connectors. Most of the existing and future demands are for housing, including maintenance in existing housing, rural electrification, and nondeferrable commercial and industrial construction.

Wiring industry representatives at the conference included Claude E. Bowers, Bowers Manufacturing Co.; R. D. Cook, Steel City Electric Co.; H. E. Kaden, Newart Manufacturing Co.; N. J. MacDonald, Thomas & Betts Co.; D. J. Murray, General Electric Co.; William Parker, Union Insulating Co.; F. E. Pope, Porcelain Products Co.; W. C. Robinson, Jr., National Electric Products Co., Murray Whitfield, Appleton Electric Co.; F. R. McQuown, All-Steel Equipment Co.; G. H. Keith Miller, Rattan Manufacturing Co.

Fifteen Nations Ratify ISO Constitution and By-Laws

The International Organization for Standardization, set up provisionally at a meeting of 25 nations in London last October, has become the official body for international standardization work following ratification of its constitution and by-laws by the national standards bodies of 15 nations, Charles leMaistre, secretary in charge of the provisional office, recently notified the American Standards Association from London, England.

The United States, which was the first country to ratify the convention setting up the new organization through approval of the board of directors of the ASA, has now been joined by the following countries: Chile, Brazil, Australia, Mexico, Finland, France, Switzerland, China, Austria, United Kingdom, Sweden, India, Czechoslovakia, Denmark.

Present plans call for the securing of temporary office space in Geneva as soon as conditions permit.

Allis-Chalmers Strikers Return Without Contract

Union Fails to Gain Objectives after 328-Day Strike—97 Leaders of Walkout Told not to Return

Members of Local 248, United Automobile Workers, C. I. O., slowly came back to their jobs this week at the West Allis plant of the Allis-Chalmers Manufacturing Co. After a 328-day strike, the longest in the history of the electrical manufacturing industry, they came back without a working contract, a 25-cents an hour raise, a union shop, or control of grievance procedure—all demands which they made on the company.

The strike officially ended Sunday when the local voted 3 to 1 to go back to work. However, 7,000 of the plant's 11,700 employees had been at work for some time, having accepted the company's offer of a raise of 18½ cents an hour, made before the strike began. The returning strikers will get the same increase.

Some Strikers Got Other Jobs

At least 1,500 of the 4,700 still "out" when the vote was taken are known to have jobs in other plants. Many of these are not expected to return. W. C. VanCleaf, director of industrial relations, advised a small group of employees (97 of the 3,200 who may return) not to report for work. The employment status of this group is in doubt, states Mr. VanCleaf, because of the disruptive acts undertaken during the strike. Each of these cases will be considered on an individual basis and each will be advised of his status in the near future. The group includes all of the local union's leaders. Harold Christoffel, honorary president, Robert Buse, president and Joseph Dombeck, vice-president. previously discharged. (ELECTRICAL WORLD, March 22. Page 6).

The strike is reported to have cost $65,000,000 in lost production and $20,000,000 in lost wages. Among the spectacular events resulting were numerous bloody riots and charges before a Congressional Committee that the strike was Communist-led.

Walter Geist, president of Allis-Chalmers, in a letter to all employees stated, "The strike is over. It has been long and costly. Cooperative action will be needed to overcome many of the resulting problems. Everyone loses in such a strike—particularly those union leaders whose aim it has long been to destroy the friendly relationship between you and the company. We will continue to fight those who try to do this."

UNION LEADERS—Joseph Dombek, left, vice-president of Local 248, United Automobile Workers, C.I.O., and Harold Christoffel, honorary president, following the meeting at which union voted to end Allis-Chalmers strike

He also informed the workers that "until the question of the selection of your bargaining representative has been determined and a new contract signed, any grievance will be handled by the interim procedure now in operation."

The court this week set aside the injunction against the Wisconsin Employment Commission which prohibited counting the contested ballots in the bargaining election. Local 248 did not appeal the court's decision, and was expected to lose enough votes thereby to lose the election.

The Wisconsin Employment Relations Board this week announced that the results of the election held January 26 were inconclusive. However, it was pointed out that the two votes cast by the union's president and vice-president could save the election for U. A. W. The board counted the final twelve of the 50 challenged ballots in the election, and the results stood at 4,135 for Local 248 and 4,019 for Independent Workers of Allis-Chalmers 117 workers voted against both unions.

The vote gave the U. A. W. local two votes less than the majority of all votes required to win certification. Votes of Robert Buse, union president, and Joseph Dombek, vice-president, were impounded because of the company's protest stating that they were no longer employees of the company. The union has entered an appeal to the National Labor Relations Board. John E. Fitzgerald, Wisconsin state board member, said that if the NLRB decides that the two are still company employees, Local 248 will have a one-vote majority and will retain its bargaining rights under the Wisconsin state law.

PL/PL

!

It's here . . . See Page 62

Nantahala Power Project Given Approval by FPC

Nanthala Power & Light Co., Franklin, N. C., has announced that it is ready to construct its Queen Creek hydroelectric project, which has been approved by the Federal Power Commission.

The project, located 17 miles west of Franklin, will consist of an earth-faced, rock-filled dam 65 ft. high and 405 ft. long. The difference in elevation between the surface of the 1,020 acre-feet reservoir and the centerline of the pelton wheel will be 1,005 ft., making it one of the highest head units in eastern America. A 2,000-hp. turbine will be installed.

The utility is affiliated with the Aluminum Co. of America and sells electric energy at retail to seven North Carolina communities and at wholesale to two utilities.

Cates Assails FTC Copper Report; Copies Still Lacking

Phelps Dodge President, Basing Comments on *Electrical World* Story, Asserts Firm Did Utmost to Maintain Output —Other Men Named in Commission Blast Continue Silence

"IRRESPONSIBLE," "in error," "charges unfounded" and "shortages attributed to government and labor" were comments heard this week on the Federal Trade Commission's report charging six prominent copper producers with responsibility for the copper shortage. The complete report was still not available for industry study, and comments were based entirely on the news story carried on Page 3 of ELECTRICAL WORLD's March 22 issue.

Most of the men named stated there would be no comment until the report can be studied. However, prominent figures in the London copper market, and L. S. Cates, president of Phelps Dodge Corp. (named in the report), did comment.

Tried to Avert Strikes

Cates, emphasizing that he had not seen the full report and was basing his comments on ELECTRICAL WORLD'S story, stated "if the Commission was correctly quoted in ascribing to Phelps Dodge Corp. a desire to curtail production of copper by delaying settlement of strikes which took place in the spring of 1946, the report is entirely in error.

"Phelps Dodge Corp. made every effort to avert the strikes. Phelps Dodge Corp. advised the unions, the Conciliation Service, and the Secretary of Labor that it would agree to the 18½-cent per hour increase (the basis on which the strikes were eventually settled) as soon as an appropriate adjustment had been made in the ceiling price of copper, but that the company believed that in view of the vast increase in labor and other costs which had taken place since 1940 without any adjustment in the ceiling price it could not absorb further wage increases without a price adjustment such as had been given in other industries. As a result of this assurance the American Federation of Labor unions at two of the company's mining properties did not strike, although the C.I.O. unions at the other three mining properties did go out."

Indicating that the accusing finger should not be pointed at industry but rather at government agencies and labor, he continued, "It was not until June 3, 1946, that the ceiling price on copper was increased. All differences with the striking C.I.O. unions at the mines were composed by June 8, 1946, although the miners did not return to work until the end of June, notwithstanding the urgings of the company, because Reid Robinson, president of the C.I.O. International, refused to let the men return to work until strikes at the refineries had been settled."

Referring to the stockpile, Mr. Cates said, "The Commission was entirely in error in its statement that the industry viewed with misgivings a worldwide stockpile of about 700,000 tons existing at the beginning of 1946. The only stockpile in the United States was held by the government. Under the stockpiling provisions of the Surplus Property Act of 1944, such copper was to be permanently stockpiled for military needs, if it were not needed for domestic civilian consumption. And it was clear that domestic demand was far in excess of domestic supply and that the government stockpile would be needed to make up the difference."

He added that the Commission's statements or insinuations were, "to say the least, irresponsible. Phelps Dodge Corp. has been for many years, and is now, endeavoring to get out the highest possible production of copper."

Informed sources in London metal circles stated that charges were "unfounded." The reasons given were that:

1. There is no world monopoly by the group of six since they control only about 40 percent of world output.

2. The shortage is attributed to bulk buying by American and British governments and to strikes in the industry.

150,000-Kw. Unit Panned

Commonwealth Edison Co. will add a 150,000-kw. turbo-generator at its Fisk plant at Chicago to incresae its capacity to 473,000 kw., the largest in the system. Cost of the unit will be $15,500,000. Coal handling facilities at the station will be enlarged at a cost of $1,100,000. The unit is scheduled to go on the line in the summer of 1949.

Will Add 2 More Units

Ohio Edison Co. will add two 60,000-kw. units to its Toronto plant on the Ohio River to increase its capacity to 300,000 kw. Coal will be used for fuel.

PERMANENT SHOW—Display of the Indianapolis Power & Light Co. which is part of the permanent Indianapolis Industrial Exposition housed in the train concourse of the Union Station. At present 93 show cases are being used to display products of 74 of the city's 900 industries. The exhibits can be seen 24 hours a day, and 70,000 visitors see them each week

New Harris Bill Restricts Lending Powers of REA

Restriction of Rural Electrification Administration lending for electric generating and transmission facilities and for acquision of existing power systems is the objective of a bill (H.R. 2709) introduced in the House this week by Rep. Oren Harris.

The measure is similar in many respects to a bill introduced last year by the Arkansas Democrat. After lengthy hearings, the House Interstate and Foreign Commerce Committee failed to report out last year's bill. The new Harris Bill has been referred to the Agriculture Committee, which is expected to be even less friendly.

The proposed legislation would amend Section 4 of the Rural Electrification Act to prevent REA loans for "acquisition, construction, operation, enlargement, or extension of any generating plant or transmission line" without the consent of the state authoriy having jurisdiction. In cases where no such state authority exists, the project would be subject to approval of the Federal Power Commission on findings that it would result "in a lower cost of electricity" than "could otherwise be obtained" by the borrower.

In addition, the measure would establish two standards for REA financing of acquisitions of generating, transmission and distribution facilities. Such loans would be forbidden (1) in towns of 1,500 inhabitants or less except where "a majority of the consumers being served by such facilities" voted their approval of the transaction; (2) in any town of more than 1,500 population.

This represents the year's first Congressional effort to curtail acquisitions of distribution lines by REA borrowers. It would prevent such deals as the recent purchases by REA-financed cooperatives of distribution systems in two North Dakota towns of more than 1,500 population.

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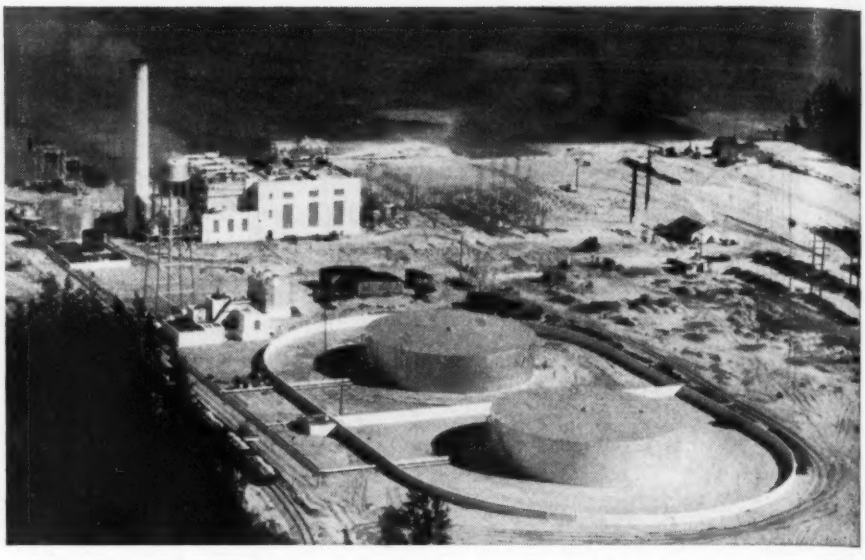
Commission Serving 21,000

With the formal taking over by the British Columbia Power Commission of the British Columbia Electric Railway Co. properties at Alberni, Port Alberni, Parksville, Qualicum, Royston, and in the surrounding territory, the government organization has added 3,000 additional customers, S. R. Weston, chairman of the commission, has announced. Another 2,600 were added by the acquisition of the Kamloops operations of the same utliity. The commission is now serving 21,000 customers.



NEW FLORIDA STATION—The 56,000-hp. steam station of the Florida Power & Light Co. at Riviera recently was put on the line by President McGregor Smith

Lilienthal Debate in Senate Goes on with Interruptions

Hope of winding up "within a few days" Senate debate on the nomination of David E. Lilienthal as chairman of the Atomic Energy Commission was expressed this week by Senators favoring confirmation. But their opponents simultaneously predicted that a final vote would not be reached for "another week or ten days."

Several factors, in addition to the outright opposition of several Senators to the nomination, figured in the delay in bringing the debate to a close. These included interruptions for discussion of U. S. participation in the International Relief Organization and proposed extension of sugar rationing and other dying war-time controls, priority business on the Senate's agenda.

Sen. Bourke B. Hickenlooper, Iowa Republican and chairman of the committee which approved the AEC nominations, opened this week's debate by repudiating charges that Lilienthal was a Communist or had "encouraged or supported" Communist activities. Republican Senators Wherry, Nebraska, and Bridges, New Hampshire, together with Democrat McKellar, Tennessee, led the attack on the Lilienthal nomination. Democratic Senators McMahon, Connecticut; Barkley, Kentucky; and Hatch, New Mexico, were the principal Lilienthal advocates.

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Kirkwood Now Consultant

Arthur C. Kirkwood, for 17 years with Burns & McDonnell Engineering Co. as associate and principal engineer, has resigned to form A. C. Kirkwood & Associates with headquarters in the Wirthman Building, Kansas City 3, Mo. Services offered include reports, appraisals, rate studies, and consultation, all complemented by engineering design services.

•

Flooding of Lands by TVA Leads to Suit for $150,000

In the first suit of its kind, Tennessee Valley Authority has been named defendant in a damage suit in Federal Court at Jackson, Tenn., seeking $150,000 on behalf of 21 persons and charging TVA with "over-stepping the bounds of civil rights under the U. S. Constitution."

The action charges that TVA has assumed and is "exercising the right to flood lands on which it holds no flood rights or easements." The suit further alleges that TVA through various surveys has determined arbitrarily the amount and location of lands to be flooded both permanently and at periodic intervals by its system of Tennessee River dams.

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120,000-Kw. Plant Planned

Alabama Power Co. will construct a new steam plant near Gadsen. Two units with a total capacity of 120,000 kw. will be installed and provision will be made for additional units. The plant will be designed to burn both coal and natural gas. The first unit is to go on the line at the end of 1948, and the second in August, 1949.

S.E.E. Engineers at Augusta Have Diversified Program

C. A. Collier, Vice-President of Savannah River Electric, Expects the Utility not the Government to Develop Clark Hill Project—Need for Employee Relations Stressed

THE ADVERSE Clark Hill decision will be appealed and the project in the end built by Savannah River Electric Co., Vice-President C. A. Collier assured the 200 attending the meetings of the Southeastern Electric Exchange's Engineering and Operation Section in Augusta, Ga., March 20 and 21. Prominent among the other well-diversified topics were discussions of labor relations, distribution at generator voltage, status of pole preservation, system planning, and disclosure of some voltage and wave distortions by capacitors.

Savannah Electric Will Appeal

Savannah River Electric Co. will appeal the adverse ruling on the Clark Hill project, said Collier, who confidently expects the company and not the government will complete the $45,000,000 development of the 65,000 hp. of firm capacity. Flood and navigation benefits are very minor factors but have been unduly exaggerated as in similar instances. He asserted the company, despite the payment of $900,000 in taxes, can produce energy at less cost than the government because of pool utilization of the 475,000,000 kw.-hr. of firm and 232,000,000 kw.-hr. of secondary energy. Collier said the stand of FPC in denying reissue of the license because of Congressional authorization of funds would, if carried to the limit, mean exclusion everywhere of private enterprise from the field of new hydro developments. The area needs the energy now, he stated.

Recent change of heart of the NLRB was welcomed by Frank A. Constangy, an Atlanta attorney, who felt, nevertheless, that laws should be enacted to narrow such latitude of personalized interpretation. He feared, however, that industry might rest on such enactments. Instead utilities need to sell themselves to their employees even better than they have sold themselves to the customers. He urged further that they be as solicitous about the welfare and mood of supervisors and office staffs as the unions are of the rank and file employees.

Nearly half the 2.3- or 4-kv. overhead system of New Orleans Public Service has now been converted to radial and tie distribution at 7.6 or 13.2 kv., said F. E. Johnson in detailing the procedure for conversion without interruption. Four new forms of single-conductor aerial cable are being tried out.

Serious dislocation of the timber and preservative supplies, in the opinion of R. H. Colley of Bell Telephone Laboratories, warrants early study and agreement on the efficacy of the prevailing alternative treatments; otherwise there will be too much dependance later on opinionated judgment. He placed reliance on the new Leutritz test which employs a cube sample atop a soil culture of growing fungi to determine the threshold of preservative effectiveness against the organisms. Telephone studies have resulted in a uniform system of branding which identifies the year, the timber, the preservative and the treater for the purpose of an informative record. Meanwhile only the permanence of the pentachlor and naphthanate alternatives need to be established.

Population is the primary index of all four categories of projected loads for the Detroit Edison Co., said E. H. Scott, statistician of that company. These components are analyzed separately and then combined. People per residential customer are still decreasing but increasing per commercial customer. Annual use was 1,153 kw.-hr. in 1946, range saturation is expected to double to 40 percent by 1955 with load factor rising from 42.7 to 50 percent. More than half the influx of war workers stayed, and the 1946 estimated peak was exceeded by 9 percent; the present demand falls on the long term trend curve.

Abnormal voltages associated with a particular capacitor installation on the Georgia Power system led R. O. Loomis to institute some 25 tests to ferret out the anomalies possible with a multiplicity of delta and wye connections of transformers and capacitors, with various phase energizings and with motor starting. Sustained voltages up to 410 volts and exceedingly high transformer exciting currents were producible. As one discusser expressed it, "the ghosts of capacitors do not always stay buried."

Needs of utilities for fleet cars and trucks are not being met by present automotive designs and production, said J. Y. Ray of Virginia Electric & Power Co.; and quality is such as to warrant thorough inspection. He sees a trend toward fluid coupling and automatic transmission. The Gar Wood winch, he feels, pays its added cost in prolonged life of the winch cable. Discussion brought out the merits of the hydraulic tail gate for delivery of heavy duty appliances and the like.

At a luncheon talk L. G. Marshall detailed the War Assets Administration program of disposal and urged that utilities study the airfields and industrial plants and advise WAA, particularly with regard to potentialities of multiple-tenancy structures and the excess capacities of the transformers. WAA is fully decentralized and most decisions can be made in local offices.

A largely off-the-record discussion of political and economic factors underlying the technical contributions of Western Europe was presented by R. C. Bergvall of the Westinghouse headquarters engineering staff. He was certain that this country, with mechanization offsetting much higher wages, can outdo those countries for some time.

Everybody Else Right

That Thomas A. Edison at one time did not foresee the possibilities of atomic energy was revealed this week when a collection of papers was auctioned in Philadelphia. On an undated paper with a series of 44 scientific and general questions answered by the inventor, the question, "Will it be possible to harness the power of the atom?" was followed by the pencilled answer, "As to the atom, I do not believe it has any internal energy as claimed. Everybody else believes it has."

2 Units for Boston

Construction plans of the Boston Edison Co. for 1947 and the years following include the installation by next fall of a third 50,000-kw. steam unit at Mystic station and an 81,250-kw. steam turbo-generator at Edgar station by the fall of 1949.

Private Utility Can't Meet Government Competition

Puget Sound Power & Light Head Favors Sale to P.U.D.'s as Only Way of Protecting Stockholders

President Frank McLaughlin told stockholders of the Puget Sound Power & Light Co. this week that an analysis of the system's position "leads to the conclusion that the stockholders' interest is best served by a sale of the property to public power agencies at a fair price."

With this statement, the solid front of opposition to further municipalization in the area which had been presented by the five companies of the region was officially broken. Actually, McLaughlin's position favoring the attempted sale of the property to a group of public utility districts for $135,000,000 has long been known.

McLaughlin, in a statement at the company's annual meeting this week, attacked "piecemeal condemnation of large integrated systems and duplication of facilities by government agencies," and asserted that Puget Sound would "continue its vigorous efforts to protect the interest of the stockholders." This he proposed to do by urging adoption of legislation counteracting the forces which have driven Puget Sound to the wall and by "endeavoring to work out some over-all plan for the sale of the entire property at a fair price."

He noted that the City of Seattle has indicated that it will not renew Puget's franchise after its 1952 expiration.

Government Advantage Great

In attacking the "tax subsidies and cheap money advantages of public power under present laws," which he said necessitates sale of the Puget system, McLaughlin asserted that these advantages, in the case of a system the size of Puget Sound, total more than $6,000,000 yearly, "which is about equal to the company's net earnings available for interest, dividends and surplus." These advantages, he continued, make it impossible for public and private power to co-exist competitively.

The Puget president said that responsibility for future adequate power supply in the Pacific Northwest rests with the federal government. He added that such a condition is "not good," but declared that "private capital will not risk investment in power plants competitive with the federal government."

Puget's ability to finance new construction which is needed, McLaughlin explained, is in doubt. He said that if the Federal Power Commission should direct the installation of additional generating units in Puget's Rock Island dam, "it will be necessary to find some way other than by the conventional methods to finance such work."

AEC and Utility Leaders Hold Unofficial Conference

Relations between the utility industry and the Atomic Energy Commission got their most thorough exploration yet at an evening get-together last week between a group of industry leaders and the members and chief officers of the AEC.

The meeting was sponsored by the Committee on Atomic Energy of the A.E.I.C. and had no official status. But it was the first time that the entire AEC had sat down with a representative utility group. In a sense, therefore, it foreshadowed the thinking of the Utility Advisory Committee which AEC is planning to name soon. This was one of the subjects discussed.

Among the utility people at the gathering were: Alex Bailey, Commonwealth Edison Co.; James Parker and Walker Cisler, Detroit Edison Co.; John Parker, Consolidated Edison Co.; K. M. Irwin, Philadelphia Electric Co.; and Philip Sporn of A. G. & E. Service Corp.

25,000-Kw. Unit Planned

Wisconsin Power & Light Co. will double the capacity of its Blackhawk plant at Beloit by installing a second 25,000-kw. turbine generator.

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

NORTH AMERICAN CO. has been granted permission to sell without competive bidding 1,714,525 shares of common stock of the Cleveland Electric Illuminating Co. to its stockholders at the rate of one-fifth of a share of such common stock at $15 per share for such stock for each share held of North American common. The unsubscribed shares are to be sold on the New York Stock Exchange. (Release No. 7273).

NEW ENGLAND GAS & ELECTRIC ASSOCIATION has received approval to sell exempt from competitive bidding the proposed cumulative convertible preferred shares and common shares to be sold pursuant to the terms of the alternate plan for recapitalization approved by the commission's order of February 11. (Release No. 7277).

Has $3,289,700 Program

The Eugene, Ore., Water Board has budgeted $3,289,700 for improvements of municipally owned electric department.

Expenditures planned for the year include: a 7,500-kw. unit at Leaburg hydroelectric plant, $383,700; a plant containing a 5,000-kw. electric unit at Waterville, $556,000; a new plant to be used as peak and standby unit containing a 25,000-kw. steam generator, more than $1,750,000, and transmission and distribution lines, $600,000.

MEETINGS

Missouri Valley Electric Association—Rural Roundtable, Hotel Continental, Kansas City, Mo., April 22; Sales and Rural Conference, Hotel Continental, Kansas City, Mo., April 23-24. I. D. Pettegrew, director, 1004 Baltimore Ave., Kansas City 6, Mo.

Indiana Electric Association—Annual Young Men's Utility Conference, IPALCO Hall, Indianapolis, April 15-16. E. F. Hauser, secretary, 1414 Circle Tower, Indianapolis, Ind.

National Electrical Wholesalers Association—Annual Convention, Hotel Traymore, Atlantic City, May 4-8. Charles G. Pyle, managing director 500 Fifth Ave., New York 18, N. Y.

American Public Power Association—Annual Convention, Hollenden Hotel, Cleveland, May 21-23. Carlton L. Neau, general manager, 1129 Vermont Ave., N. W., Washington 5, D. C.

Previously Listed

Midwest Power Conference—Palmer House, Chicago, March 31-April 2.

Southeastern Electric Exchange—Annual Conference, Vinoy Park Hotel, St. Petersburg, Fla., April 3-5; Home Service Conference, Thomas Jefferson Hotel, Birmingham, Ala., May 13-14.

Edison Electric Institute—Annual Sales Conference, Edgewater Beach Hotel, Chicago, March 31-April 3; Engineering Committee, Edgewater Beach Hotel, Chicago, April 28-30.

National Association of Corrosion Engineers—Annual Conference and Exhibition, Palmer House, Chicago, April 7-10.

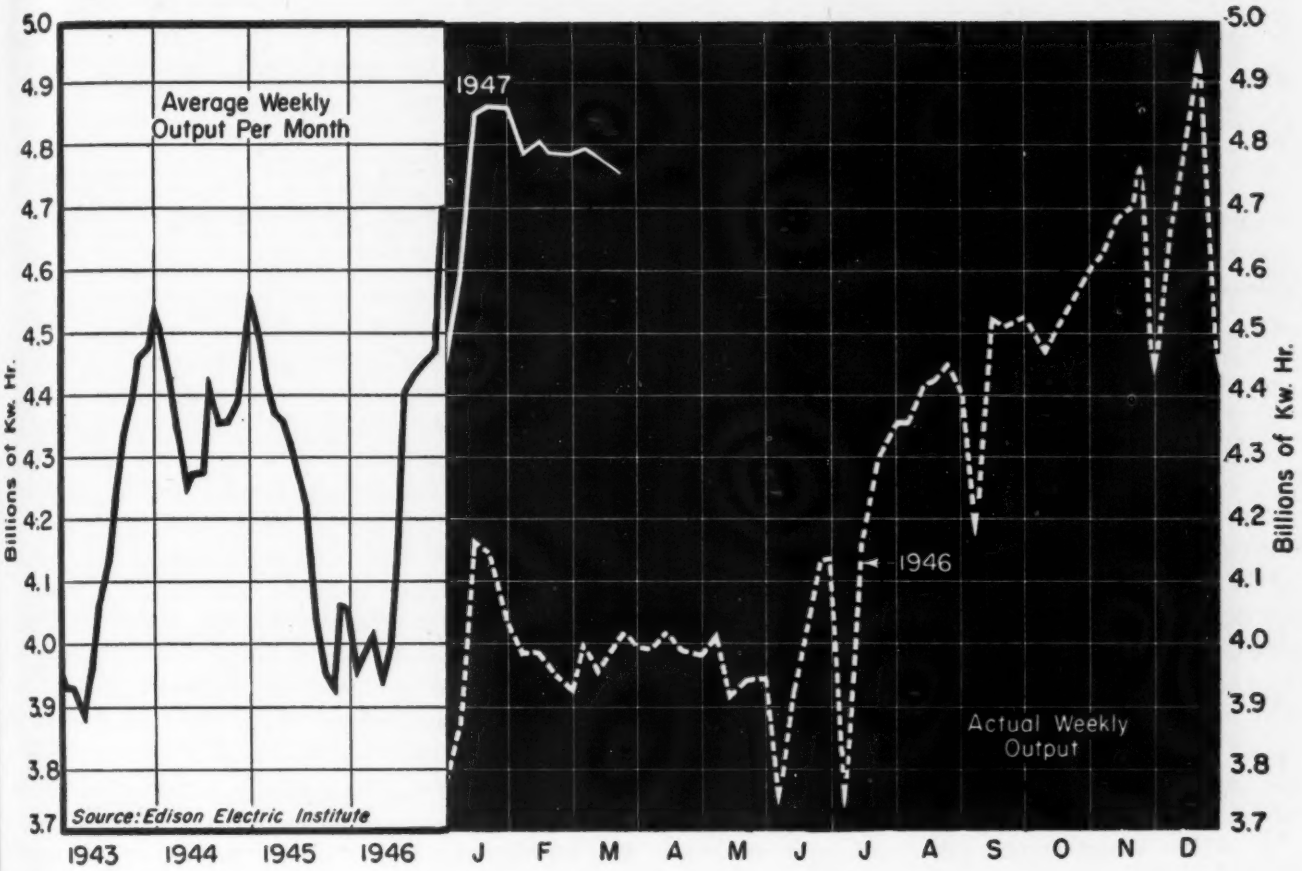
Northwest Electric Light & Power Association—Engineering and Operation Section, Multnomah Hotel, Portland, Ore., April 9-11; Business Development Section, Olympic Hotel, Seattle, Wash., May 7-9.

Electrochemical Society—Spring Congress, Hotel Brown, Louisville, Ky., April 9-12.

Missouri Valley Electric Association—Engineering Conference, Hotel Continental, Kansas City, Mo., April 16-18.

National Rural Electric Cooperative Association—Annual Meeting, Davenport Hotel, Spokane, Wash., April 22-25.

Pennsylvania Electric Association—Meter Committee, Roosevelt Hotel, Pittsburgh, April 10-11; Systems Operation Committee, Hotel Statler, Buffalo 5, N. Y., April 24-25.



Indiana Passes Measure to Prevent Utility Strikes

Indiana has joined the states which have passed legislation to prevent strikes or lockouts in the electric utility industry.

The Indiana bill, which was introduced in the General Assembly late in February (ELECTRICAL WORLD, March 1, Page 47), provides a series of steps to be followed whenever there is any danger that utility services may be interrupted by a labor dispute.

First step is the selection of a conciliator from a permanent panel of ten. If he fails to secure a settlement within 30 days, the second step is taken by the appointment by the governor of three arbitrators from a permanent panel of 30. The arbitrators have 60 days in which to conduct hearings and reach a decision, but the governor has the right to give the arbitrators another 60 days if needed.

If either party is dissatisfied with the arbitrators' decision, it has 15 days in which to appeal to the Circuit Court where a judge will hear the case without a jury. His decision will be final. If the arbitrators are reversed, the governor can reopen proceedings at either of the two previous steps.

All strikes and lockouts are barred during the entire time of these proceedings.

The Indiana law is unusual inasmuch as the arbitrators can only determine the proper interpretation and application of the provisions of a contract if one is in force. If a new contract is the basis of the dispute, the arbitrators are to establish rates of pay and conditions of employment which are comparable to the prevalent rates paid and conditions of employment at other utilities in the same labor market area or if there are none, in adjoining labor market areas in Indiana.

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Utility Buying Energy

Kentucky Utilities Co. has signed a contract with the Owensboro, Ky., municipal system to buy 150,000,000 kw.-hr. of energy during the next four years in return for $750,000.

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New Unit at Savannah

Savannah Electric & Power Co. will install a 20,000-kw. turbine in its Riverside steam station at Savannah. Cost of the unit, boilers, and auxiliary equipment will be about $3,500,000.

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15,000 Kw. Unit Planned

Eastern Shore Public Service Co. of Maryland will add a 15,000-kw. turbo-generating unit, boiler, and auxiliaries to its Vienna, Md., plant.

Output Decline Continues

Continuing the usual seasonal trend which began this month, the amount of electrical energy distributed by the light and power industry during the week ended March 22, 1947, dropped to 4,759,066,000 kw.-hr. However, this was an average increase of 18.5 percent over the 4,017,310,000 kw.-hr. distributed during the week ended March 23, 1946. During the week ended March 15, 1947, the figure was 4,763,843,000 kw.-hr.

The Edison Electric Institute figures showed considerable increase of output in all regions of the country with the Central Industrial region taking the lead with a 23 percent gain.

Weekly Output, Millions Kw.-Hr.

1947		1946		1945	
Mar. 22	4,759	Mar. 23	4,017	Mar. 24	4,402
Mar. 15	4,764	Mar. 16	3,988	Mar. 17	4,398
Mar. 8	4,787	Mar. 9	3,953	Mar. 10	4,446
Mar. 1	4,797	Mar. 2	4,000	Mar. 3	4,472
Feb. 22	4,778	Feb. 23	3,923	Feb. 24	4,474
Feb. 15	4,778	Feb. 16	3,949	Feb. 17	4,472
Feb. 8	4,801	Feb. 9	3,983	Feb. 10	4,505
Feb. 1	4,777	Feb. 2	3,983	Feb. 3	4,539
Jan. 25	4,856	Jan. 26	4,034	Jan. 27	4,577
Jan. 18	4,857	Jan. 19	4,145	Jan. 20	4,588
Jan. 11	4,853	Jan. 12	4,163	Jan. 13	4,614
Jan. 4	4,574	Jan. 5	3,865	Jan. 6	4,427

Percent Change from Previous Year

	Mar. 22	Mar. 15	Mar. 8
New England	+11.5	+11.5	+13.0
Mid-Atlantic	+11.8	+12.1	+13.6
Central Industrial	+23.0	+23.3	+23.8
West Central	+16.3	+18.4	+18.1
Southern States	+21.4	+24.2	+27.2
Rocky Mountain	+ 9.1	+10.6	+13.0
Pacific Coast	+19.9	+20.2	+23.1
Total United States	+18.5	+19.5	+21.1

Electrical World
OPINION

The Washington Method

THE recent Federal Trade Commission report on copper (ELECTRICAL WORLD, March 22, page 3) is described by those who have seen it as being in two volumes "about the size of the Manhattan telephone directory." Two copies of it, according to competent reporters, were sent to the Capitol, where newsmen were permitted to search them. Another was available at FTC. A week and one-half later, a "summary" was made available generally. The full report still is not to be had.

Were this a non-controversial report, such a method of releasing it would best be described as sloppy. But this report contains serious allegations—charges which imply the possibility of prosecution—assertions which can not fail to capture prominence wherever they are published. For it to be released as it was is not sloppy, but irresponsible. It's an old Washington trick—one which grows less savory with repetition.

Not yet having had sufficient access for thorough study, ELECTRICAL WORLD frankly does not—and the companies cannot—know whether the report's data, conclusions and allegations are correct. It does feel that the report's presumption of validity can only be seriously impugned by such sly, deceitful tactics as FTC used in making it public.

329 Days—For What?

THREE HUNDRED AND TWENTY-NINE days after it began, the Allis-Chalmers strike has ended without a contract being signed. Local union leadership took its dwindling membership back to work to preserve its bargaining rights, threatened by a growing independent union. To cover the retreat, President Robert Buse of Local 248 asserted, according to the *New York Times:*

"We want to assure the members of Local 248 that the union will never surrender to this arrogant and despicable company."

This is the Robert Buse who signed a Communist candidate's nominating petition, the Buse whose relations with the Communist line recently have been under investigation. The 11,000 employees affected directly by this strike may choose between the invective of a beaten unioneer and their own first-hand knowledge of 329 payless, fruitless days.

Who Shall Sell Appliances?

SIDETRACKED by war, the utilty merchandising controversy now reappears—this time in Alabama. The Alabama Power Co., has been asked, in effect, to show cause why it should not halt sale of electric appliances.

Entirely aside from the merits or demerits of utility merchandising, there exists today a condition that should be thoroughly understood before decision is made. This is the fact that there are too many electric appliance dealers—many more than the business will support.

Some post-war surveys show less than 200 electric utility customers per appliance dealer. This ratio is impossibly low for profitable business. When competition begins to pinch, they will cry "Unfair" at their most vulnerable rival—the electric utility.

As appliance production rises, as the market turns to the buyer, more and more dealers will drop out. They will not have been forced out by the competition of electric utilities, but by competition—period. This competition will not be from sellers that maintain prices and quality, but from dealers with dwindling resources desperately trying to stay in a game they do not know.

In the 'thirties, Kansas and Oklahoma prohibited appliance sales by utilities. The Oklahoma law remains in effect; Kansas' soon was declared unconstitutional. In many other states, unsuccessful efforts were made to outlaw utility merchandising. The arguments, pro and con, are the same now as before, but the circumstances surrounding them are quite different. It probably will not be long until dealers lacking in sales ability, business acumen and financial resources will have been squeezed out. Then will be the time for commissions and legislatures to examine and decide the cases before them, unaffected by the complaints of men who see their dreams of large and easy profits from small investments turn into demands for hard work and long purses.

Goodbye to the "Trouble" Department

THE word "trouble" will no longer be associated with the Hartford Electric Light Co.'s activities. The word was eliminated from the Installation and Inspection Division's designation. "Customer Service" henceforth will be the salutation which will greet persons who call or telephone the utility on emergency matters. The new plan also junks the term "Trouble Calls" for trip reports. These changes have been made because of the feeling that "trouble" is not a part of the company's business, but that "Customer Service" is.

Such decisions coincide with a far-reaching trend in

modern business. That is to focus customer attention on service rather than on handicaps to it—on values received by purchasers rather than costs to them for goods, advice or services. In utility offices, blunt adjurations to "Pay Bills Here," and signs pointing to "Complaint Departments" no longer harmonize with the objectives of friendly management. True, the word "Service" often has been abused in commerce, where little more than ordinary sale of commodities for cash occurs; but service is still an objective of the power industry. It involves the widest gamut of human cooperation, from every-day relations with customers to the sacrifice of life itself in extreme emergencies. The more the public can be brought to perceive electric utilities as service organizations rather than as enterprises to whom operating troubles are misfortunes, the better for customer relations.

Kokomo Says "No"

ADDITIONAL to Gallup poll and other evidences that public approval of government in business is subsiding comes now some testimony from Kokomo. In this Hoosier community, the city clerk presented a report to the common council setting forth the political bliss of tax reductions from profits of municipal utility operations. He announced that petitions would be circulated calling for an election to authorize the city to acquire the local electric, gas and water utilities.

Personnel of the three companies rang some door bells getting signatures on a petition of their own. At the next council meeting, they turned up with 9,785 names of people who wanted no more government in business. The crusading clerk, who had gained his office in an election in which 12,057 votes were cast, abandoned his project.

Hartford's New Mercury Boiler

HARTFORD ELECTRIC LIGHT'S decision to replace its South Meadow mercury boiler with a new one and to revamp the present mercury turbo-generator signifies the company's confidence in this process. Experience at the Kearney station of the Public Service Co. of New Jersey doubtless contributed to this decision. But over the years, the pioneering of the General Electric Co. and the financial and engineering courage of Hartford's Ferguson and Soren have borne rich fruit.

The economies of the mercury vapor process, when articulated with steam units, are now well known to the industry. It suffices to say that this latest program, involving approximately $2,000,000, can be counted on to save over $300,000 yearly in fuel. It will enable the company to operate two of its 20,000-kw. steam-turbine units at full rating. Service reliability, often questioned by engineering skeptics, has met the stiff requirements of the day. The program illustrates afresh the far-reaching scope of modern fuel-burning plant developments, and the importance of treating their problems unifiedly.

WASHINGTON COMMENT

By R. N. LARKIN

BY a coincidence of timing, the spotlight has been thrown simultaneously on two aspects of the privately owned electric power industry's attitude toward the federal competition it faces.

In the Southwest, privately owned electric power companies are fighting the expansion of the Interior Department's five-state holding company—the Southwestern Power Administration. Conversely, in the Northwest, the president of one company—Puget Sound Power and Light—has dropped the fight against another of Interior's power trusts—the Bonneville Power Administration.

McLaughlin's comments to Puget's annual meeting this week are not intrinsically different from those which the Southwestern companies have been laying before Congressional appropriations committees for several years. But McLaughlin's proposed solution is diametrically opposed, not only to that of his Southwestern colleagues, but as well to that of the remainder of his Northwestern associates.

The Southwesterners, vigorously as they fight federal encroachment, have conceded that if SPA evolves as planned, private ownership of electric power in that region would disappear. The difference between McLaughlin and the Southwesterners, aside from the decision which each has made, lies in the extent to which federal encroachment has affected each. The fight is young in the Southwest. In the Northwest, it is much older, and commands much stronger local support.

Congress' interest in this situation is apparent. It would be hard to find a dozen members of the 80th Congress who would hesitate to avow, publicly, their devotion to private enterprise. But it will be much more difficult to find enough members who will vote, either by roll call or anonymously, this avowed devotion to such a specific form of free enterprise as the electric power industry, long under attack by statism.

McLaughlin's conclusion is at least timely. It shows again that the threat of nationalization through federal-public-ownership is not unrealizable. It shows that extinction of private enterprise by attrition can and does happen here. It happened in Tennessee. It happened in Nebraska. It seems to be happening in Washington state. It is threatened in Arkansas, Oklahoma, Texas, Louisiana and Missouri. Less immediately, it is threatened in Georgia, Florida, Virginia, North Carolina and in all Western states.

Where does that leave Congress? In a converse of the situation which faced Congresses of two decades ago—those Congresses which voted dry and drank wet. Ultimately, that decision was reached and taken. Some day, the decision on private enterprise versus government enterprise in power will be reached and taken.

Adequate Control Voltage From Storage Batteries

WAYMAN A. HOLLAND
Switchgear Div.,
General Electric Co.
Philadelphia, Pa.

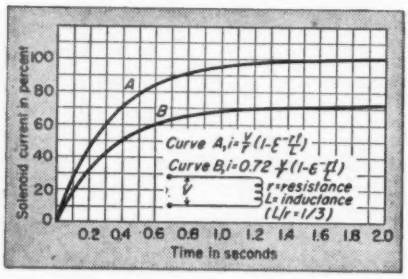


FIG. 1—Build-up of current in a solenoid with constant magnetic circuit A for 100 percent rated voltage, B for 72 percent with L = r/3

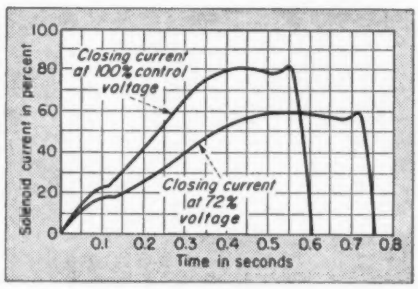


FIG. 2—Closing current curves of a power circuit breaker solenoid operating mechanism. Closing times were 33 cycles (0.55 sec.) and 44 cycles (0.733 sec.)

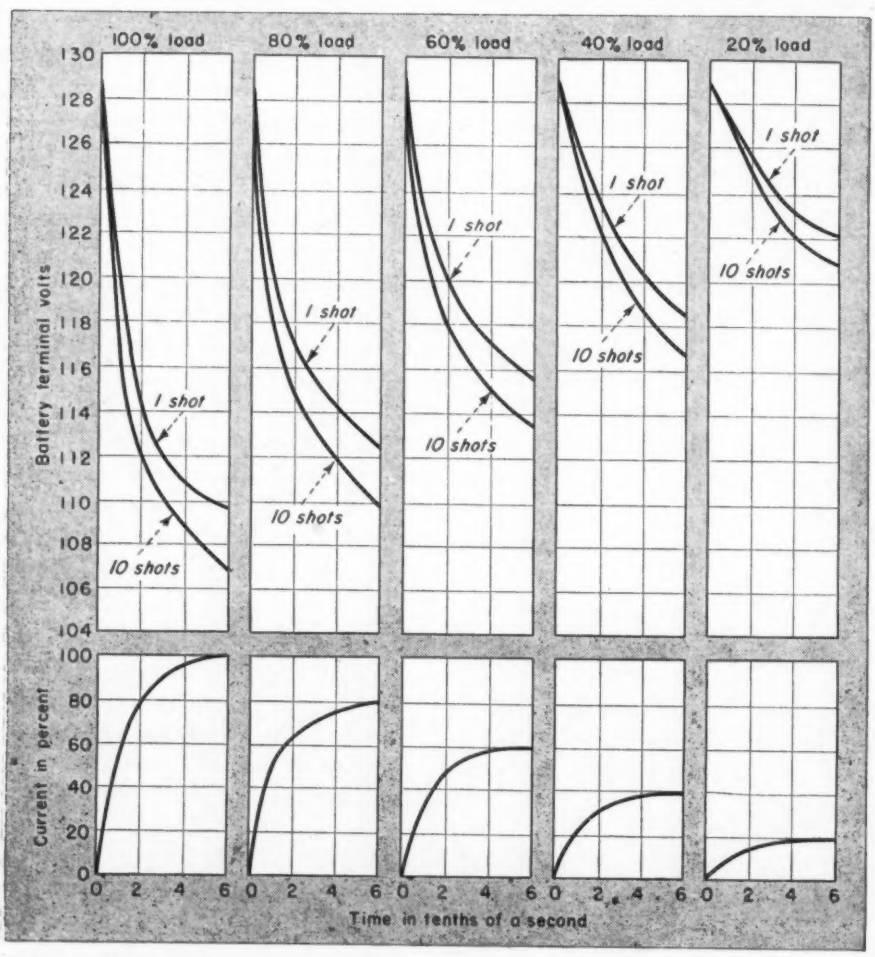


FIG. 3—Voltage characteristics of typical lead-acid storage battery, 60 cells, fully charged and floating on 129-volt source, inductive load imposed for 0.6 sec. at 20-sec. intervals; loads varying from 100 to 20 percent of 1-min. battery rating

ADEQUATE CONTROL VOLTAGE at the terminals of electrically operated mechanisms of circuit breakers and other switching devices in a power station is essential to enable them to operate properly and in conformity with their ratings. For most breakers at least 90 percent of rated control voltage is required for this purpose and this article discusses the characteristics of lead-acid storage batteries in order to demonstrate their ability to supply operating current at this required voltage.

For years it has been the practice to furnish 60-cell lead-acid batteries for the control power source for nominal 125-volt, and 120-cell for nominal 250-volt, control buses. It has been the usual custom, also, to select these batteries on the basis of load demand, in amperes, for one minute, down to 1.75 volts per cell, or 105 volts at the terminals of a 60-cell battery with full one-minute rated current flowing. This voltage is reduced by the ohmic drop in the connections between the battery and the electrical operating mechanism.

Mechanism Test Specifications

Circuit breaker mechanisms are tested at rated voltage (that is, at 125 volts for 125-volt mechanisms) and they are specified according to A.S.A. and NEMA Standards, to have an operating range, for closing, from 90 to 130 volts (or 180 to 260 volts for 250-volt mechanisms), that is, 72 percent to 104 percent of rated voltage. Thus, a 105-volt battery, less the conductor drop, providing 90 volts at the mechanism terminals, will success-

fully close a breaker although not necessarily at its full rating.

Calculated "build-up" of current in an inductive circuit, such as in a solenoid with constant magnetic circuit, is shown in Fig. 1. In a power circuit breaker mechanism solenoid the magnetic conditions are not constant because of the movement of the solenoid plunger as it is drawn into the coil, but the same general characteristics apply, as shown in Fig. 2, drawn from an oscillograph of an actual operation. The closing time at 100 percent voltage was 33 cycles (0.55 second) while at 72 percent voltage the closing time was 44 cycles (0.733 second). Not only is the operation slower at the lower voltage, but there is naturally less current and, consequently, less power, so that under some abnormal conditions, the mechanism may even be unable to complete the closing operation.

90 Percent Stipulated

Such a possibility has resulted in an operating requirement that the control voltage must be not less than 90 percent of the rated voltage of the mechanism, where the breakers are subject to fault conditions to cause currents approaching the breaker's maximum ratings. This means 112.5 volts at the mechanism terminals for 125-volt mechanisms.

This requirement immediately raises the question—"How to get 112.5 volts at the mechanism terminals from a battery with a one-minute rating to give 105 volts at the battery terminals?" Very little information was available concerning the characteristics and behavior of batteries under conditions of loads imposed for fractions of a second such as are prevalent in circuit breaker operation. The general understanding had been that under the heavy short-time loads imposed by circuit breaker mechanisms the battery voltage immediately dropped to some value and then remained practically constant for approximately a minute; hence, the rating of "for one minute to 1.75 volts per cell."

In an attempt to get accurate data several manufacturers of lead-acid storage batteries were asked to make tests simulating actual breaker operation, taking oscillographic records with speeds of approximately 280 to

Analysis of tests of lead-acid storage batteries to determine ability to supply operating current for electrically operated mechanisms at the 90 percent of rated control voltage prescribed by standards

290 in. per minute. Tests were made with currents corresponding to approximately 100, 80, 60, 40 and 20 percent of the one-minute to 1.75 volts-per-cell rating of the battery tested. The L/r ratio (that is, induction to resistance ratio, or current build-up rate) is practically the same in large, medium and small solenoids, and consequently five solenoid mechanisms, of a representative size, were chosen to be tested with a battery having a "one-minute to 1.75 volts per cell" rating approximately equal to the current taken by the five solenoids in parallel. Thus the five would provide the 100 percent load, four, the 80 percent, and so on down to one for the 20 percent load. So as to provide uniform results constant magnetic circuits were arranged by permanently blocking the solenoid plungers in the "breaker closed" position. This eliminates the varying rates of build-up shown in Fig. 2, likely to occur at different times with a number of solenoids in parallel, and gives voltages negligibly different from what would be obtained under normal conditions.

To simulate the closing of a group of breakers in quick succession the loads were applied ten times (ten "shots") at 20-second intervals. The duration of each load application was 0.6 second (36 cycles), which compares with the operating time of the typical breaker.

Results of Tests

Tests were made under the following conditions:

(a) Battery fully charged and floating at 129 volts.

(b) Battery fully charged, with no charger connected.

(c) Battery discharged 50 percent, with no charger connected.

Note: For the benefit of the battery manufacturers' research other tests were also made, though not mentioned here.

Condition (a) is the normal one

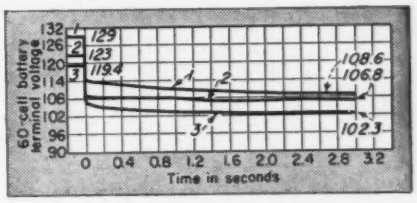


FIG. 4—Approximate volt-time characteristics of typical storage battery discharging at its 1-min. rating to 1.75 volts per cell, non-inductive load. Curve 1, battery floating at 2.15 volts per cell; curve 2, battery fully charged, no charger connected; curve 3, battery 50 percent discharged, no charger connected

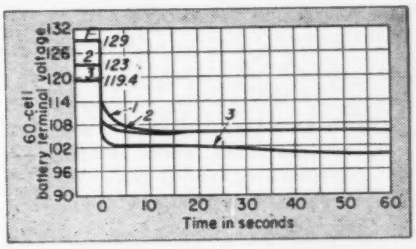


FIG. 5—Approximate volt-time characteristics of typical battery discharging at its 1-min. rating to 1.75 volts per cell, non-inductive load. Individual curves for same conditions as in Fig. 4

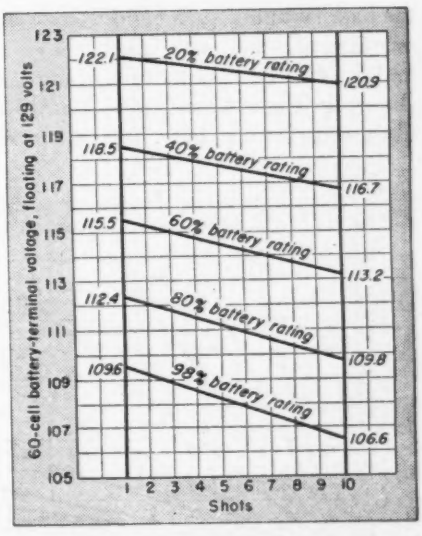


FIG. 6—Battery terminal voltage at various values of load (inductive as in Fig. 3) with loads imposed at 1 to 10 shots, at 20-sec. intervals, each shot of 0.6-sec. duration. Percentages of battery rating are in amperes for 1 min. to 1.75 volts per cell

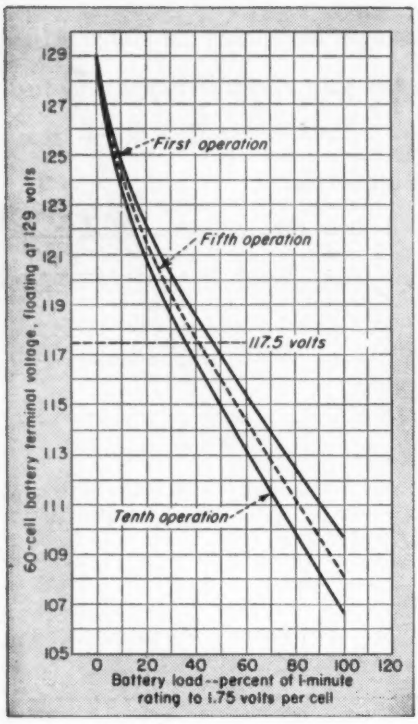


FIG. 7—Variations of battery terminal voltage under intermittent inductive load, 60 cells. First operation—load for 0.6 sec.; fifth operation—load imposed 5 times, each time for 0.6 sec. with 20 sec. between loads; tenth operation—load imposed 10 times

encountered in power stations, and accordingly of most interest to the object of this article. Conditions (b) and (c) may exist at times of loss of charging power, but these are abnormal, and since the results of the tests show that the behavior of the battery under such conditions was not inconsistent with the behavior under (a), the results, other than as shown in Figs. 4 and 5, will not be discussed further here. The battery data included in the following statements, and those shown in Figs. 3 to 7, inclusive, are based directly upon, or are taken from, the reports of the tests. The battery data have been corrected to 77 F., with the battery electrolyte at the manufacturer's recommended density.

It should be remembered that storage batteries are not "precision" apparatus, and that tests on other batteries, even of the same manufacturer and the same rating, may differ as much as two volts above or below the values obtained from a given test. The values used in the curves of Figs. 3, 6, and 7 are the lowest obtained in the tests of the several batteries; and, consequently, are "pessimistic."

A set of curves (Fig. 3) shows the voltage characteristics of a typical 60-cell battery floating on a 129-volt source, with solenoid loads varying from 20 to 100 percent of the one-minute rating of the battery to 1.75 volts per cell, with simultaneous plotting of current and corresponding voltage against time, plotted in tenths of a second.

Figs. 4 and 5 show the effects of continued application of 100 percent one-minute rated current for 3 seconds and for 60 seconds, respectively, for three conditions of operation; namely, fully charged and floating on a 129-volt (2.15 volts per cell) source; fully charged but open circuited before application of load; and 50 percent discharged, open circuited before application of load. In Fig. 5, it will be noted that there is an instantaneous drop 129 volts to 114.9 volts, with a continuing decrease for approximately 15 seconds, when the voltage approaches the 1.75 volts per cell rating (105 volts) for one minute. The load applied for Figs. 4 and 5 was noninductive; that is, with no delay in the current build-up, and the battery was one having higher voltage characteristics than those of Figs. 3, 6, and 7.

Effects of repeated shots (solenoid loads) are shown in Fig. 6, drawn upon an assumption that the decrement of voltage on successive shots follows a straight line (in uniform steps); (it does not exactly, but sufficiently nearly so for practical purposes). Fig. 7 is drawn from the values in Fig. 6.

Practice Proposals

By reference to such curves as Fig. 7 it will be seen that it is easy to select a battery of suitable rating to provide the required terminal voltage at the specified load. For general use it is proposed to limit the drop from battery to mechanism terminals to 5 volts with an average of five closing operations at 20-second intervals. This will permit the reclosure of five breakers in rapid succession, and it is somewhat more severe than the usual 3-shot automatic reclosing duty cycles. Hence, it is a conservative proposal considered.

Fig. 7, then, indicates that the load demand should be not greater than 40 percent of the one-minute to 1.75-volt-per-cell rating of the battery in order to obtain proper control voltage (117.5 volts at the battery terminals). But, as stated the values in Fig. 7 are pessimistic. Curves similar to Fig. 7 for all of the batteries tested show a range in permissible battery load (for 117.5 volts, five closing operations) from the 40 percent of Fig. 7 to 57.5 percent of the one-minute rating.

Fig. 8 shows the voltage drop, at 100 amp., for various lengths and sizes of control cable.

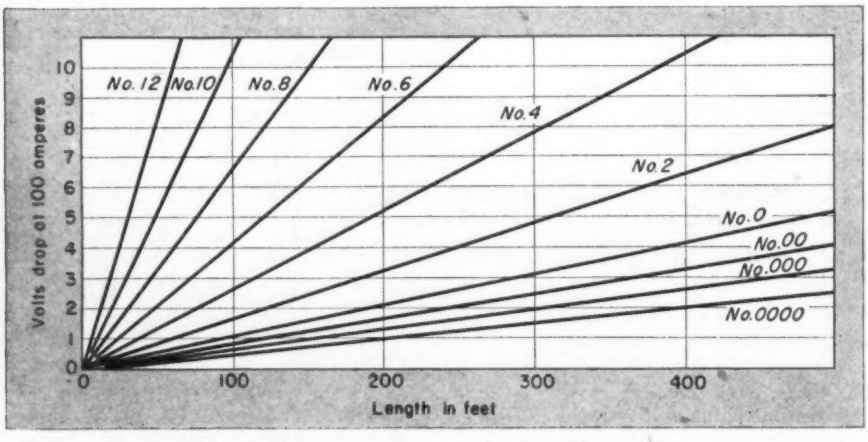


FIG. 8—Voltage drop at 100 amp. in control cables (25 C.). For drop at any current, I, multiply drop shown on chart by I/100. For other temperatures increase drop as follows: 40 C. 1.058; 50 C. 1.096; 100 C. 1.289

Acknowledgments

For the cooperation in providing the facilities, making the tests, and furnishing the data taken therefrom, the author makes acknowledgment to the following battery manufacturing companies: The Electric Storage Battery Co., Philadelphia, Pa.; The Gould Storage Battery Corp., Depew, N. Y.; The Philco Corp., Storage Battery Division, Trenton, N. J.

SELECTION OF POLYPHASE SQUIRREL-CAGE MOTORS

Basic information on types and characteristics with quick reference tables and charts for ready selection of correct motor, starter and protection

N. H. ERLANDSON, Distribution Design Engineer, Carolina Power & Light Co.

SIMPLEST and most rugged device for converting electrical energy into mechanical motion, the polyphase squirrel-cage motor is, generally, lowest in cost, highest in efficiency and easiest to maintain of all motor types. Because they are manufactured in a wide range of characteristics suitable for a variety of applications, squirrel-cage motors should be selected with considerable care to suit starting and running conditions of the applied load. Tables and charts of this article bring together in one place most of the data necessary for motor selection.

Basic feature of squirrel-cage motors is the absence of any electrical connection between stator and rotor, with resulting elimination of wearing parts such as commutators, slip rings, brushes, etc. Rotors consist of slotted laminations, Fig. 1, with uninsulated copper, copper and brass, or aluminum bars short circuited at each end of the rotor. In some designs the rotor winding is cast into the laminations to produce a one-piece winding.

General purpose motors with Class A insulation are usually rated for 40 deg. C. temperature rise based on an ambient temperature of 40 C. Totally inclosed motors are built for 55 C. rise with Class A insulation and 75 C. rise with Class B insulation. All other types, including splash-proof, are rated 50 C. rise with Class A and 70 C. rise with Class B insulation.

Standard voltage ratings of usual types are: 110, 208, 220, 440, 550, and 2,300 volts. Manufacturers guarantee satisfactory operation at voltages 10 percent above or below nominal. However, single-phase motors manufactured after April, 1941, are rated 115/230 volts so that 220-volt polyphase motors and 230-volt single-phase motors may be found operating on the same circuit.

Many general purpose motors, and others rated 40 C. rise, carry a "service factor" guarantee to run continuously at 115 percent of rated load (at rated voltage and frequency) with an added temperature rise of approximately 10 C.

All modern polyphase motors have frame numbers in accordance with standards of the National Electrical Manufacturers Association. The first two digits, when divided by four, give distance in inches from center line of horizontal motor to bottom of feet. Third digit is distance from center line of motor to center line of mounting holes in the feet as would be shown in side-view drawing. For details see NEMA standard MG 4-15. An additional letter, if present, refers to shaft length if other than standard.

For proper performance, motor torque available at the shaft must be well above torque required by the load. Values usually specified, either in ft.-lb. or percent of full-load torque, are: (1) starting torque, (2) pull-up torque, (3) full-load torque, and (4) pull-out torque.

Condensed from manuscript chapter of a proposed book on motors and motor applications. Republication rights reserved by the author. Much useful data has been obtained from Allis-Chalmers Mfg. Co., General Electric Co., and Westinghouse Electric Corp.

DEFINITIONS

GENERAL PURPOSE
Any motor 200 hp. or less, 450 rpm. or more, having a continuous rating and offered for use without restrictions to a particular application

OPEN TYPE
Self ventilated, no restrictions to air flow other than necessitated by mechanical construction

SPLASH PROOF
Ventilating openings so constructed that liquid or solid particles falling within 100 deg. from vertical cannot enter case directly, by striking or running along surface

TOTALLY INCLOSED
So incased as to prevent exchange of air with surroundings, but not air tight

WATER PROOF
Totally inclosed to exclude water in the form of a hose stream

RATING
Mechanical output at the shaft in horsepower

$$\text{Hp.} = \frac{\text{Watts} \times \text{Efficiency}}{746}$$

$$\text{Hp.} = \frac{\text{Torque} \times \text{Shaft rpm.}}{5250}$$

Where efficiency is expressed as a decimal and torque is used as ft.-lb.

TEMPERATURE RISE
Ratings of 40, 50, 55, 70 and 75 deg. C., depending on type of motor and service, are based on maximum allowable rise of winding at full load for ambient temperature of 40 C. (104 F.)

SLIP
Difference between synchronous speed of the revolving magnetic field and actual speed of the rotor, usually in percent of synchronous speed

TORQUE
Turning effect, or turning moment, a motor exerts on its shaft (usually expressed in ft.-lb. or percent of full-load torque)

TYPES, CHARACTERISTICS AND APPLICATIONS

A NUMBER of significant motor types are included in the group generally termed polyphase squirrel-cage motors. Reference to these is either by NEMA class or by a general description of motor torque, starting current or slip. See Table I. Trend of manufacturers is toward eliminating Class A motor in favor of Class B. Principal reason for this change is demand for motors with low starting current. With reduction in starting current, cost of reduced-voltage starting equipment can be eliminated for certain sizes. Use of Class B motor results in a slight reduction in starting torque and decrease in pull-out torque.

One of the desirable features of polyphase squirrel-cage motors is the wide range of characteristics obtainable. Table I indicates basic data of types widely manufactured. Characteristics of various sizes and makes vary somewhat, so that general values in Table I should be supplemented by more exact data from individual manufacturers for a specific case.

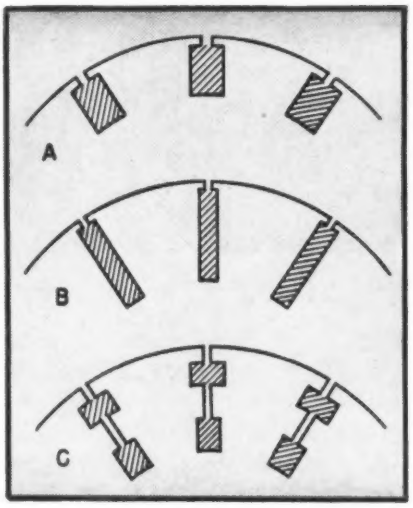


FIG. 1—Class A has rotor bars close to surface, low resistance and low reactance. Class B has deep, narrow rotor bars for high reactance during starting. Class C has two sets of rotor bars, outer with high resistance and low reactance, inner with low resistance and high reactance

Change in motor characteristics is, for all practical purposes, obtained by design of rotor slots and rotor bars, Fig. 1. Generally speaking, increasing resistance of rotor bars increases starting torque but results in higher slip and decreased efficiency. Increase in reactance of rotor circuit reduces starting current but decreases torque available. Since rotor characteristics are fixed for any individual type and cannot be changed (as for slip-ring motors) it is obvious that all desirable characteristics cannot be obtained in a single motor.

TORQUE REQUIREMENTS

Best means of selecting proper size and type of motor for a specified load is, of course, correlation of speed-torque curves of motor and driven machine. If speed-torque curves are not available, or for approximate estimates, average values of torque for various types of load are given in Table II as a guide in selection of proper motor. Table II includes pull-in torques for synchronous motors for comparison.

Torque values quoted by manufacturers, and those shown in the table,

TABLE I — POLYPHASE INDUCTION MOTOR CHARACTERISTICS

NEMA CLASS	TYPE	SPEED, RPM	STARTING CURRENT*	STARTING TORQUE*	PULL-OUT TORQUE*	APPROX. SLIP, %	EFF., %
A	Normal torque Normal starting current	1800 1200 900	600-750 600-700 575-675	180-225 160-200 135-180	200-300 200-300 200-275	3-5 3-5 3-5	85 to 90
B	Normal torque Low starting current	1800 1200 900	450-550 450-550 450-550	125-180 125-180 115-140	200-250 200-250 200-225	2-4 2-4 2-4	90
C	High torque** Low starting current	1800 1200 900	450-550 450-550 450-550	225-275 200-250 190-225	200-250 200-225 190-200	3-7 3-7 3-7	85 to 90
D	High slip	1800 1200	300-350 300-350	300-400 300-400	300-400 300-400	15-20 15-20	Rel. low
D Modified	High slip	1800 1200	325-375 325-375	300-400 300-400	300-400 300-400	15-20 15-20	Rel. low
	Medium slip	1800 1200 900	375-450 375-450 375-450	300-350 300-350 300-350	300-350 300-350 300-350	7-12 7-12 7-12	85 to 90
E	Low starting torque Normal starting current	1800 1200	650-750 650-750	75-100 75-100	200-300 200-300	2-3 2-3	85 to 90
F	Low starting torque Low starting current	1800 1200 900	350-400 350-400 350-400	75-100 75-100 75-100	150-160 150-160 150-160	3-5 3-5 3-5	85 to 90

*Approximate percent of full-load value
**Double squirrel cage

TABLE II—TORQUE REQUIREMENTS OF VARIOUS APPLICATIONS

(In percent of full-load torque)

APPLICATION	Starting Torque	Pull-in Torque	Nominal Pull-in Torque 95% Speed	Pull-out Torque
Attrition mills	60	60	130	175
Ball Mills:				
For rock products	140	100	125	140
For ore	160	110	130	140
Banbury Mixers	125	100	110	250
Band Mills	60	30	115	250
Beaters—Standard	125	100	110	150
Beaters—Breaker	125	100	110	200
Blowers—Centrifugal				
Inlet or discharge valve closed	30	60	75	150
Inlet and discharge valves open	30	100	125	150
Blowers—Positive Displacement				
Rotary—by-passed	40	30	50	140
Chippers—empty	50	60	100	250
Compressors—Centrifugal (see Blowers)				
Compressors—Nash Hytor—unloaded	40	40	55	140
Compressors—Reciprocating				
Freon	30-60	30-80	40-100	140
Air and gas	40	20	40	140
Ammonia (discharge pressure 100-250 lbs per sq in.)	40	20	40	140
Carbon Dioxide				
Single cylinder, Double Acting				
Piston rod diam=30% piston diam.	40/55	20	40	140
Piston rod diam=40% piston diam.	60/75	20	40	140
Piston rod diam=50% piston diam.	85/100	20	40	140
Piston rod diam=60% piston diam.	120/135	20	40	140
Two cylinder, Double Acting—90 deg cranks				
Piston rod diam=30% piston diam.	40/45	20	40	140
Piston rod diam=40% piston diam.	45/60	20	40	140
Piston rod diam=50% piston diam.	65/80	20	40	140
Piston rod diam=60% piston diam.	90/105	20	40	140
Two cylinder—Single or Double Acting 180 deg cranks	40	20	40	140
Crushers—Cone—unloaded	100	75	100	250
Crushers—Gyratory—unloaded	100	75	100	250
Crushers—Jaw—unloaded	125	75	100	350
Crushers—Roll—unloaded	100	75	100	250
Edgers	30	30	110	250
Fans, Centrifugal (Except Sintering Fans)				
Inlet or discharge valve closed	30	60	75	150
Inlet and discharge valves open	30	100	130	150
Fans—Centrifugal—Sintering				
Inlet Gate closed	30	100	130	150
Fans—Propeller or Disk type	30	100	130	150
Generators—Electroplating	40	15	40	140
Generators—Standard AC or DC				
Continuous rated	12	8	20	150
25% overload rating	15	10	25	200
Grinders—Magazine pulp	50	50	60	140
Grinders—3 or 4 pocket pulp	30	30	60	140
Hammer mills—unloaded	100	100	150	250
Jordans—Plug-out	50	50	75	150
Jordans—Plug-in	50	100	110	150
Line shafts—Flour Mill	175	100	130	150
Rubber Mill	125	100	130	250
Plasticators	125	100	110	175
Pumps—Centrifugal—discharge valve				
Closed—high or medium load	30	60	100	150
Discharge valve open	30	100	125	150
Pumps—Reciprocating—started dry	30	30	40	150
By-passed	40	40	40	150
Not by-passed (3 cylinder)	150	100	110	150
Pumps—Screw type—started dry	30	30	40	140
Primed—discharge valve open	30	100	125	140
Rod Mills	160	110	130	140
Rolling Mills				
Blooming and Slabbing Mills—3 high	35	25		300
Structural Rail Roughing Mill	35	25		300
Structural and Rail Finishing Mills	40	30		250
Plate Mills	35	25		300
Merchant Mill Trains	60	40		250
Billet, Skelp and Sheet Bar Mills, continuous with Lay Shaft Drive	40	30		250
Rod Mills, continuous with Lay Shaft Drive	75	40		250
Hot Strip Mills, Continuous, Individual Drive	25	20		250
Tube Piercing and Expanding Mills	40	30		250
Tube Rolling Mills	40	30		300
Tube Reeling Mills	60	40		250
Hot Sheet and Tin Mills	125	100		400
Cold Sheet and Tin Mills	200	100		250
Brass Copper Roughing Mills	50	35		250
Brass Copper Strip Finishing Mills	150	100		250
Rubber Mills—Open Roll Type	125	100	120	250
Saws—Gang	100	50	100	150
Saws—Trimmer	100	75	120	150
Screens—Paper Mill	50	50	100	150
Shredders	50	50	100	250
Tube Mills (See Ball Mills)				
Vacuum Pumps, Jennings Hytor				
Used in Paper Mills	60	100	130	200
Other applications	40	55	70	140
Vacuum Pumps, Nash Hytor				
Used in Paper Mills	60	100	130	200
Other applications	40	55	70	140
Vacuum Pumps—Reciprocating	40	20	40	140
Wood Hogs	60	100	125	225

Courtesy General Electric Co.

DRIVEN MACHINERY
Induced and forced draft fans, centrifugal pumps, cotton gins, shapers, planers, lathes, line shafts, joiners, sanders, circular saws, buffers, drill presses, motor-generator sets, milling machines, etc.
Pumps, compressors, conveyors, stokers, grinders, hammer mills, turn tables, band saws, presses, crushers, sand mixers, pug mills
Passenger and freight elevators
Hoists, lifts, small cranes
Punch presses, shears, crushers with flywheels
High-speed centrifugal pumps and fans
Centrifugal pumps, blowers and fans

are based on nameplate voltage. For other values of applied voltage, torque varies as the square of the voltage. For example, with one-half nameplate voltage the starting torque will be one-quarter of that obtained with full voltage.

Reduced values of torque resulting from reduced voltage must be taken into consideration when selecting a motor for a specific load. Also, if the time required for acceleration exceeds about 20 seconds, the effect of heating may require a special motor or special starting equipment.

Class A motors are intended for constant-speed conditions with relatively infrequent load fluctuations, normal starting torque and continuous duty. A service factor provides for overload conditions. Class B motors have approximately the same characteristics as Class A but require less starting current. Class C provides for heavy starting duty with either continuous or intermittent operation and include a service factor for overload.

Class D, high-slip, are intended for intermittent duty, single-speed, reversing, and provide high starting torque. Modified types for medium slip provides high starting torque, high efficiency for continuous duty with service factor for overloads. Class E for continuous duty has high efficiency and low starting torque with service factor for overloads. Class F has the same characteristics as Class E but designed for low starting current and higher slip.

STARTING, STARTERS AND VOLTAGE DROPS

SINCE maximum current occurs at the instant of starting, greatest disturbance to the distribution system accompanies initial closure of a motor circuit. Locked-rotor currents, based on full voltage, are quoted by manufacturers for use in calculating the effect of starting a motor on other apparatus in the same and adjoining circuits. It should be noted that locked-rotor current varies directly as the applied voltage.

The inherently high value of locked-rotor current in polyphase squirrel-cage motors, which in some cases offers a serious handicap, has resulted in the use of the term "free-rotor" current, taken as 75 percent of the locked-rotor current.

All motors manufactured since November, 1941, (polyphase induction, synchronous and single-phase capacitor motors over ½ hp. but not wound-rotor or single-phase repulsion-induction types) have a code letter stamped in an individual block on the nameplate indicating locked-rotor kva. input per hp. at full voltage and frequency. Tabulated values here include the lower figure of each range and all intermediate values up to but not including the higher figure. Currents have been calculated for 220 volts, three phase.

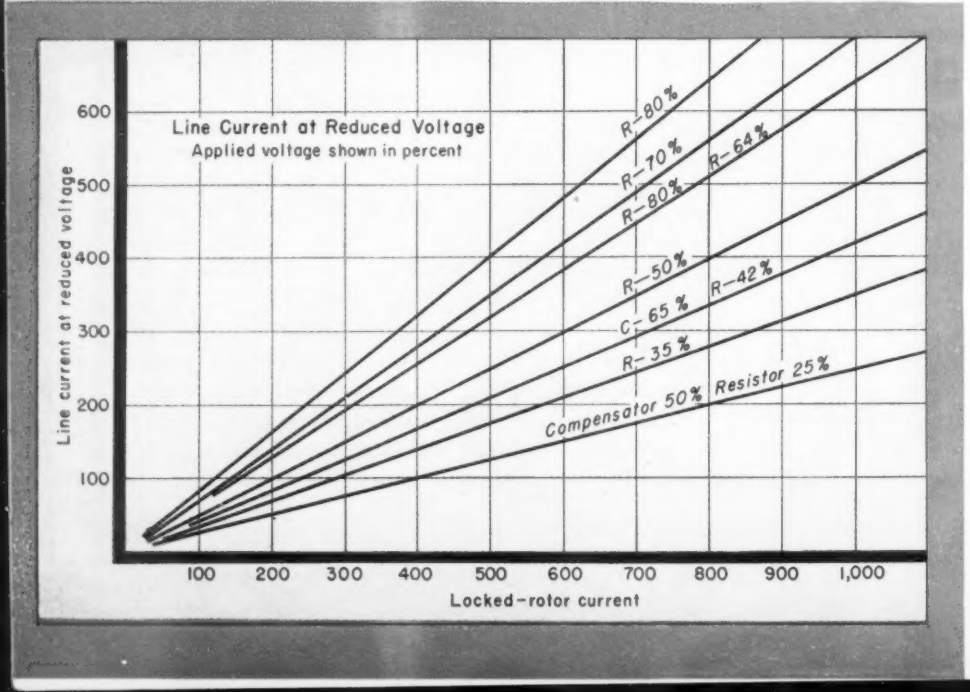
These code letters have no relation to NEMA class letters used for classification of motors.

All modern squirrel-cage motors are, or can be, designed for across-line starting without damage to the windings. However, the inherent high value of locked-rotor current may produce objectionable voltage drop and result in excessive flicker of lights or damage to belts or other mechanical transmission. Common methods of starting include (1) across the line and (2) reduced voltage. In the latter class are (1) compensator or auto-transformer, (2) primary resistance, (3) reactor, and (4) wye-delta.

ACROSS-LINE

Minimum investment and maximum simplicity are afforded by connecting the motor terminals directly across the line in starting, either by a manual or magnetic switch. Starting torque is of maximum value, as is starting current also. Across-line starting is widely applied to smaller sizes of motor, or any installation where no serious flicker results.

Code letter	Kva. per hp.	Amp. per hp.
A	0–3.15	0–8.26
B	3.15–3.55	8.26–9.33
C	3.55–4.0	9.33–10.5
D	4.0–4.5	10.5–11.8
E	4.5–5.0	11.8–13.1
F	5.0–5.6	13.1–14.7
G	5.6–6.3	14.7–16.5
H	6.3–7.1	16.5–18.6
J	7.1–8.0	18.6–21.0
K	8.0–9.0	21.0–23.6
L	9.0–10.0	23.6–26.2
M	10.0–11.2	26.2–29.4
N	11.2–12.5	29.4–32.8
P	12.5–14.0	32.8–36.7
R	14.0–Up	36.7–Up



COMPENSATOR

Two auto-transformers in open delta, or three in closed delta, with taps giving output voltages at less than line value, constitute a compensator starter. Taps at 80 percent, 65 percent or 50 percent of line voltage are connected to the motor terminals by a switching mechanism during the starting cycle. In the running position the auto-transformers are disconnected from the circuit and full voltage applied to the motor.

Current taken by the motor varies directly as the applied voltage but line current on the incoming side of the starter varies as the square of the applied voltage. For example, if a motor with locked-rotor current of 600 amp. at full voltage is started with an 80 percent tap compensator, the motor current will be 600 x 0.8 or 480 amp. and the line current is 600 x 0.8 x 0.8 or 384 amp. Starting torque also is 0.8 x 0.8 or 0.64 of the full-voltage value.

When the transfer is made from the reduced-voltage tap to full voltage on the ordinary type of compensator starter, the motor is momentarily disconnected from the circuit, resulting in an additional line disturbance. This effect can be eliminated by a wye connection of three auto-transformers and added auxiliary switching equipment. During the change from reduced voltage to full voltage the neutral connections of the three auto-transformers are opened leaving each auto-transformer in the circuit as a series reactor. The reactor is then by-passed with the final step being to disconnect the auto-transformers from the line and to connect the motor directly to the line.

PRIMARY RESISTOR

A resistor in series with the motor limits current during the starting cycle and is short circuited for normal running. Resistance starters are manufactured in single or multiple steps, the latter being termed "increment" starters. Another type employs a stack of carbon discs compressed

mechanically during the accelerating period and short circuited for running.

Since the resistor is connected in series with the motor, line current and motor current are equal. For a specified value of line current, therefore, starting torque will be less than that available from a compensator starter. Increment starters are usually employed when starting limitations are based on a specified rate of current increase.

REACTOR

Less commonly used than compensator or resistor types, series reactors afford a smooth accelerating curve but of longer duration than compensator or resistor starters. Current and torque values are the same as for resistor type.

WYE-DELTA

Six leads of a delta-connected motor are all brought out to a switching arrangement which provides for starting with the windings connected wye and then changed to delta for normal operation. With this arrangement both starting current and starting torque are fixed at about one-third of that produced with full voltage. Low fixed value of starting torque without any great saving in cost of starter restrict application of this type equipment.

DISTRIBUTION SYSTEM

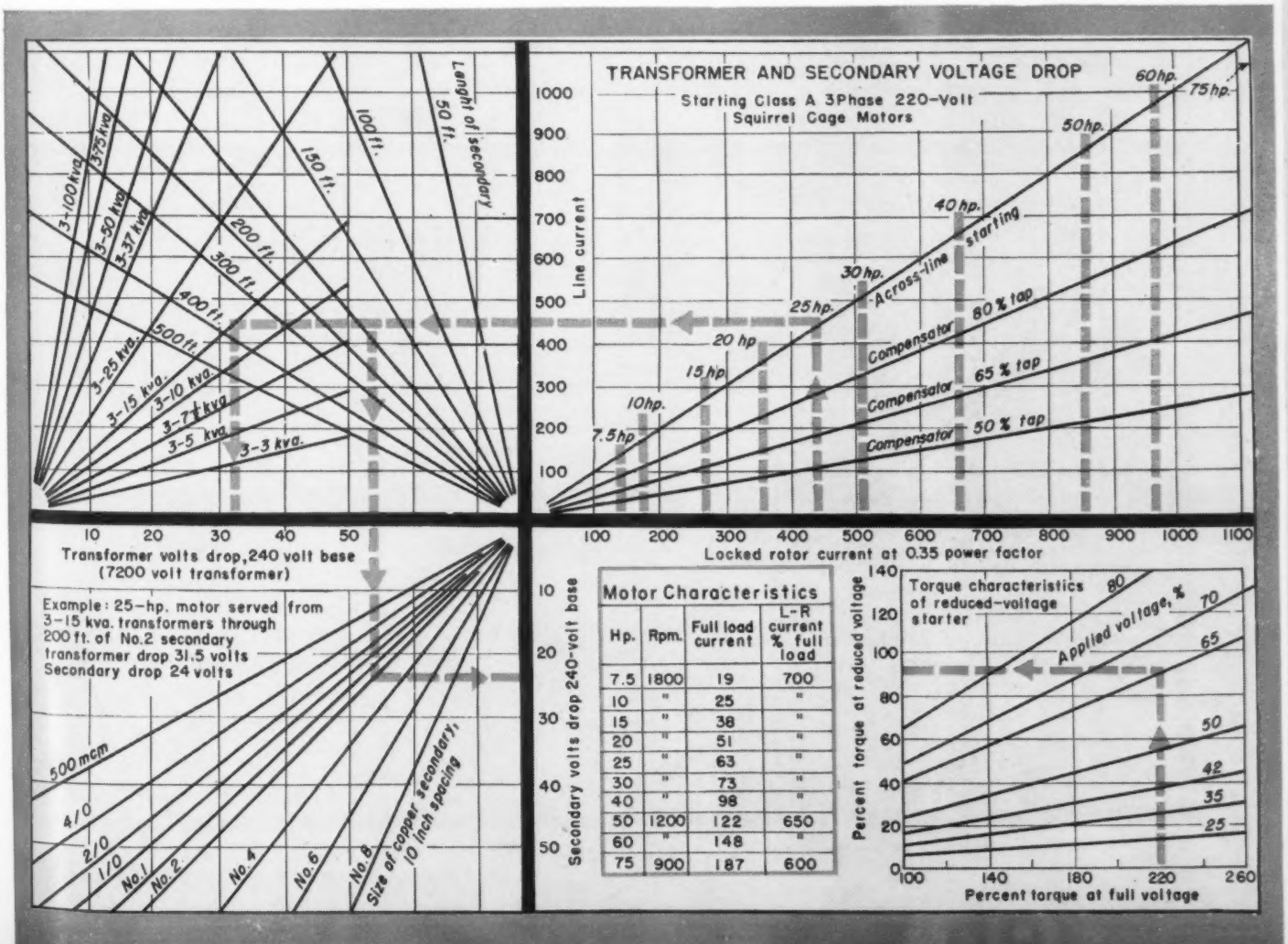
Inherent high values of locked-rotor current of squirrel-cage motors may result in objectionable voltage drop with across-line starting. Amount of drop, depending on size and type of motor, size of transformer and conductors, circuit voltage, etc., determines starting method needed. It is usual practice of power companies to specify maximum size and voltage of motor that may be started across the line.

Where allowable starting current is set at some value less than locked-rotor current, the required starting tap can be selected from chart, opposite page, for compensator, resistor and reactor starters. For example, a motor with a locked-rotor current of 600 amp. and an allowable starting current of 250 amp. requires a compensator starter tap at 65 percent voltage or a resistor or reactor starter with 42 percent voltage applied to the motor.

The resulting starting torque for these values of starting voltage can be determined from the chart in lower right of Fig. 2. For example, a motor with 220 percent full-voltage starting torque (in percent of full-load torque) will start at 92 percent torque when connected to a 65 percent compensator tap and at 39 percent torque when connected to a 42 percent resistor or reactor tap.

Voltage drop resulting from starting various sizes of 220-volt three-phase motors up to 75 hp. with across-line or compensator starters can be readily found from chart. For a 25-hp. motor, for example, started across the line, the voltage drop across a bank of three 15-kva. single-phase, 7,200-volt transformers is approximately 31.5 volts. Assuming 200 ft. of No. 2 copper secondary, an additional 24 volts drop will occur.

The charts give, of course, only approximate values. They do not take into account the change in locked-rotor current resulting from lower actual voltage actually applied to starter or motor terminals.



TEMPERATURES, LOADING, PROTECTION

THE SUBJECT of allowable operating temperatures of motors causes more unnecessary service calls and worry than any other item in the operation and maintenance of motors. Lack of thorough understanding of the temperatures for which motors are designed leads to the "touch and yell" method of determining motor temperatures.

Allowable temperature rise for general purpose motors is 40 C. above a 40 C. ambient, or 80 C., which is 176 F. Safety engineers set the limit of tolerance for human flesh at about 150 F. Obviously some parts of a fully loaded motor are too hot for comfort as measured by human hands. Furthermore, many motors carry a service factor of 1.15, or 15 percent more than rated load, which provides safe operation under unusual circumstances at 10 C. above normal, or 194 F. at the hottest part of the stator.

Most suitable method for determining motor temperature in industrial plants is the thermometer method, mercury thermometers or thermocouples placed on the stator at locations of maximum temperature with bulbs or leads covered with putty or felt to shield the temperature-sensitive device from air currents. To allow for poor bulb contact, impossibility of measuring hottest spot temperature and other variables, limiting thermometer readings are set at 50 C. for class A insulation and 70 C. for class B. If an imbedded detector is used, temperature readings may be 10 C. higher. It is also possible, and somewhat more accurate, to determine winding temperature by measuring "cold" and "hot" resistance and calculating temperature from change in resistance.

MOTOR LIFE

Basically, any insulation deteriorates with age, and the rate becomes more rapid as temperature is raised. One manufacturer states that a motor-life expectancy of from 12 to 28 years at 100 C. is reduced to from 3 to 8 years by increasing operating temperature to 120 C., neglecting all other factors.

However, most motors operate at ambient temperatures less than 40 C. (104 F.) and for less than 24 hours per day. One manufacturer estimates that motor life, under ordinary circumstances, should be 20 years or more if operated 8 to 16 hours per day at ambient temperatures of 30 C. (86 F.) or lower. Also, motors fail for other reasons than high-temperature operation, for example, from misapplication, mechanical failure and, perhaps most commonly, lack of proper maintenance.

LOADS BY CLIP-ON AMMETER

Clip-on ammeters do not provide as accurate measurement of load as can be obtained by wattmeters, but, when properly used, give results satisfactory for average conditions. No motor shutdown or disconnection of leads is needed as usually required for wattmeter measurement.

Current flow, of course, does not give an immediate measure of load due to the fact that magnetizing current increases only a small amount from no load to full load. Chart shows an approximate relation between current and load for various motor sizes and speeds. In most instances actual current values at one-quarter, one-half, full and one and

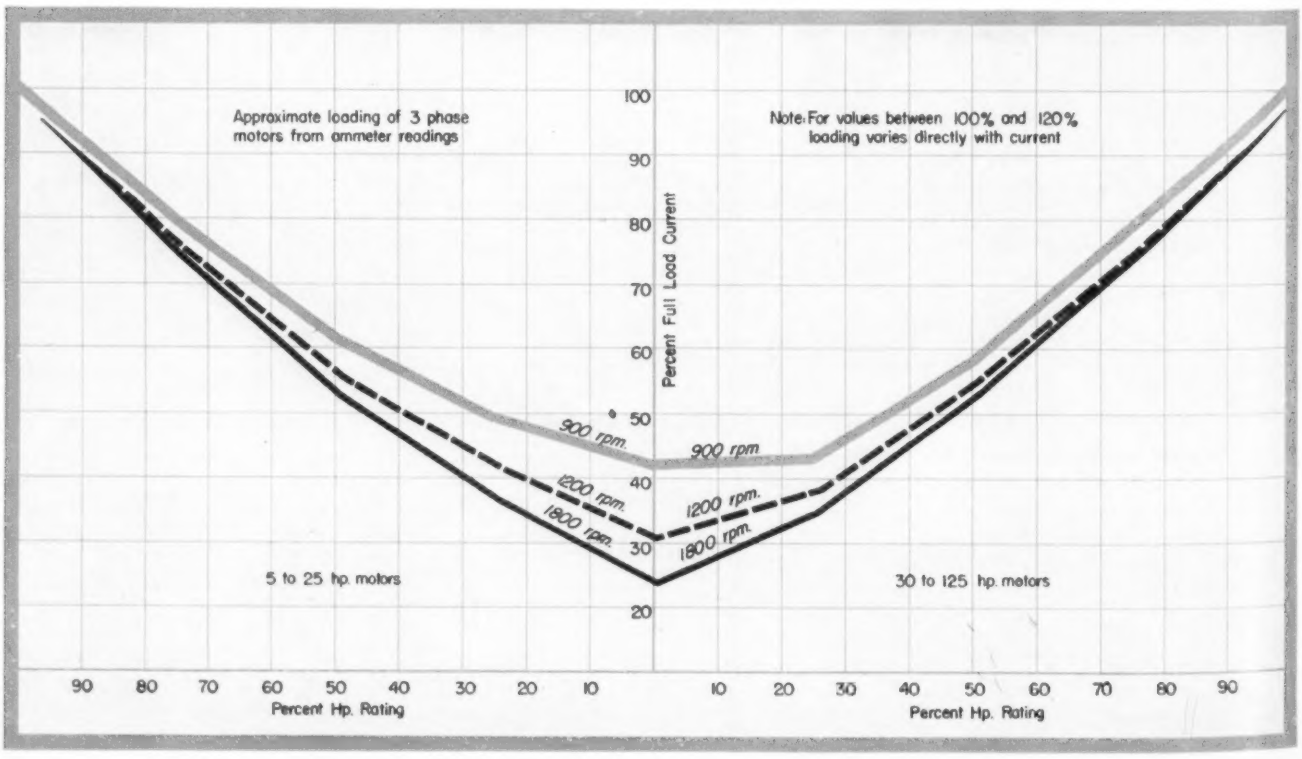


TABLE III—CONDUCTOR SIZES AND OVERCURRENT PROTECTION FOR MOTORS

Full-load Current Rating of Motor	Minimum Size Copper Wire, AWG or MCM			Running Protection of Motors		Maximum Allowable Rating of Branch-Circuit Fuses			
	Type T Synthetic Insulated	Type R Code Grade Rubber	Type RH Heat-Resistant Grade Rubber	Max. Rating of Fuses	Max. Setting of Time-limit Device	ACROSS LINE RESISTOR and REACTOR STARTING Code Letters F to R	ACROSS LINE RESISTOR or REACTOR STARTING Code Letters B to E*	Compensator Code Letters B to E	All Motors Code Letter A
Amperes				Amperes	Amperes				
26	8	8	10	35	32.5	80	70	60	40
30	8	8	8	40	37.5	90	70	60	45
36	6	6	8	45	45.	110	90	80	60
40	6	6	6	50	50.	125	100	80	60
46	4	4	6	60	57.5	150	125	100	70
50	4	4	6	60	62.5	150	125	100	80
56	4	4	4	70	70.	175	150	120	90
60	3	3	4	80	75.	200	150	120	90
66	2	2	4	80	82.5	200	175	150	100
70	2	2	3	90	87.5	225	175	150	110
76	2	2	3	100	95.	250	200	175	125
80	1	1	3	100	100.	250	200	175	125
86	1	1	2	110	107.5	300	225	175	150
90	1/0	1/0	2	110	112.5	300	225	200	150
96	1/0	1/0	1	125	120.	300	250	200	150
100	1/0	1/0	1	125	125.	300	250	200	150
110	2/0	2/0	1/0	150	137.5	350	300	225	175
115	2/0	2/0	1/0	150	144.	350	300	250	175
120	3/0	3/0	1/0	150	150.	400	300	250	200
125	3/0	3/0	2/0	175	156.5	400	350	250	200
130	3/0	3/0	2/0	175	162.5	400	350	300	200
135	4/0	4/0	2/0	175	169.	450	350	300	225
140	4/0	4/0	3/0	175	175.	450	350	300	225
145	4/0	4/0	3/0	200	181.5	450	400	300	225
150	4/0	4/0	3/0	200	187.5	450	400	300	225
155	4/0	4/0	3/0	200	194.0	500	400	350	250
160	...	250	3/0	200	200.	500	400	350	250
165	...	250	4/0	225	206.	500	450	350	250
170	...	250	4/0	225	213.	500	450	350	300
175	...	300	4/0	225	219.	600	450	350	300
180	...	300	4/0	225	225.	600	450	400	300
185	...	300	4/0	250	231.	600	500	400	300
190	...	350	250	250	244.	600	500	400	300
200	...	400	250	250	250.	600	500	400	300
210	...	400	300	250	263.	...	600	450	350
220	...	400	300	300	275.	...	600	450	350
230	...	500	300	300	288.	...	600	500	350
240	...	500	350	300	300.	...	600	500	400
250	...	500	350	300	313.	...	...	500	400
260	...	600	400	350	325.	...	...	600	400

From National Electrical Code, 1947

* Also compensator starting, code letters F to R

one-quarter loads can be obtained from the manufacturer or calculated. The relation is correct only for nameplate voltage at motor terminals.

PROTECTION

Overcurrent protective devices such as fuses, thermal relays and circuit breakers are intended to prevent damage to equipment from overly large currents and also to isolate one circuit from the rest of the system in event of trouble. Settings larger than those recommended in Table III defeat the purpose of the protective equipment and may result in damage. Values shown are for 10 hp. and larger; for continuous-duty motor in the 1- to 5-hp. range, overcurrent protection should be 125 percent of full-load current or less.

Table IV lists recommended maximum settings of motor branch circuit protective devices in percent of motor full-load current. Where these values do not correspond to standard ratings of fuses, circuit breakers, thermal cutouts or thermal relays, next larger size or rating may be used. Also if overcurrent protection is not sufficient for starting, the rating may be increased as necessary up to but not more than 400 percent of motor full-load current. For details see National Electric Code, 1947.

TABLE IV—SETTING OF MOTOR BRANCH CIRCUIT PROTECTIVE DEVICES
(In percent of full-load current)

Starting method, motor type	Fuse rating	Circuit breaker setting, time limit
Across-line, resistor or reactor		
Code letter A	150	150
Code letters B to E	250	200
Code letters F to R	300	250
No code letter	300	250
Compensator starting		
Code letter A	150	150
Code letters B to E	200	200
Code letters F to R	250	200
No code letter, under 30 amp.	250	200*
No code letter, over 30 amp.	200	200

* High-reactance motors — 250%

SUPPLY VARIATIONS, COSTS

POLYPHASE squirrel-cage motors operate successfully under conditions of voltage and frequency appreciably different from rated values, but not necessarily at speed, efficiency and temperature rise obtained when operating with rated voltage and frequency. In general, satisfactory operation can be expected with (1) voltage variations 10 percent above or below rating, (2) frequency variations of 5 percent above or below rating, and (3) sum of voltage and frequency variations not exceeding 10 percent with frequency variation limited to 5 percent above or below rating. Table V shows the approximate effect of voltage and frequency variations on the characteristics of polyphase motors.

In respect to voltage variations, note that good practice dictates feeder conductors of such size that voltage drop under normal load conditions will be no more than 3 percent for feeders supplying power loads only and 1 percent for combined power and lighting loads.

COSTS

A general indication of comparative costs for typical squirrel-cage motors, wound-rotor motors and their respective starting devices is given in Table VI. Table is comparative only.

Table VII gives full-load current values for various voltages.

TABLE V—EFFECT OF SUPPLY VARIATIONS

	Percent Rated Voltage		Percent Rated Frequency	
	110%	90%	103%	95%
Torque, Starting and running	21%	— 19%	— 10%	11%
Speed Full-load Percent slip	1% — 17%	— 1.5% 23%	5% Slight	— 5% Slight
Efficiency Full-load Half load	0.5 to 1% — 1 to 2%	— 2% 1 to 2%	Slight Slight	Slight Slight
Power Factor Full-load Half-load	— 3% — 5 to 6%	1% 4 to 5%	Slight Slight	Slight Slight
Current Starting Full-load	10 to 12% — 7%	— 10 to 12% 11%	— 5 to 6% Slight	5 to 6% Slight
Temperature rise Overload capacity, max.	— 3 to 4 C. 21%	6 to 7 C. — 19%	Slight Slight	Slight Slight

TABLE VI—COMPARISON OF TYPICAL MOTOR AND STARTER COSTS

Motor size, hp.	Sync. speed, rpm	Class A or B with compensator	Class C with comp.	Slip-ring* with drum. cont.	Compensator only, 220 & 440 volts	Slip-ring* control only
15	1800	$324	$333	$695	$141	$257
20	1800	365	381	847	147	323
25	1800	399	418	955	147	365
30	1800	500	526	1005	153	384
40	1800	658	688	1218	259**	482
50	1200	814	896	1440	267**	526
60	1200	922	1019	1744	277	716
75	900	1161	1292	2063	287	798

*Starter includes primary controller, under-voltage and overload protection, secondary drum and interlock.
**440-volt compensators $161.

TABLE VII—APPROXIMATE FULL-LOAD CURRENTS, AMPERES
Three-phase squirrel-cage motors

Hp.	208-v.	220-v.	440-v.	550-v.	2200-v.	Hp.	208-v.	220-v.	440-v.	550-v.	2200-v.
3	9.5	9	4.5	4	...	40	107	101	51	40	10
5	16	15	7.5	6	...	50	132	125	63	50	13
7.5	23	22	11	9	...	60	158	149	75	60	15
10	29	27	14	11	...	75	190	180	90	72	19
15	40	38	19	15	...	100	260	246	123	98	25
20	55	52	26	21	...	125	328	310	155	124	32
25	68	64	32	26	7	150	380	360	180	144	36
30	82	77	39	31	8	200	508	480	240	195	49

VOLTAGE CALCULATION
On Multi-Grounded Rural Lines

Multiple current path reduces voltage drop 25-35 percent—Value important as full line capacity is utilized—Calculations checked by tests

JOSEPH S. FRANCIS
Engineering Dept.
Consumers Power Co.
Jackson, Mich.

CALCULATIONS of voltage drop on single-phase, multi-grounded lines can be made simply and accurately by the use of special constants in the usual voltage drop formulas. Although it is well known that the grounded wire and ground present a multiple current path and hence a lower impedence and reduced voltage drop, very little has been published on the subject of constants to be used.

Conservative approximations are often made, or the effect of the earth return is neglected entirely. As rural lines become more heavily loaded, this reduction in voltage drop becomes more important in calculations. Otherwise the full capacity of the lines may not be utilized or a large amount of unnecessary distribution plant may be planned and installed. Unless the reduction is taken into consideration, calculated voltage drops will be in excess of actual voltage drops by some 25 to 35 percent.

TABLE I
Self and Mutual Impedence

Wire Size	Strand	Ohms per Mile Resistance	Zg
2 Copper	3	0.873	0.966 + j 1.536
3 "	3	1.101	1.194 + j 1.550
4 "	1	1.374	1.467 + j 1.573
6 "	1	2.185	2.278 + j 1.601
2 ACSR	6x1	1.41	1.50 + j 1.56
4 "	6x1	2.24	2.33 + j 1.58
6 "	6x1	3.56	3.65 + j 1.61
4A-CWC	1x2	1.40	1.49 + j 1.58
6A "	1x2	2.25	2.34 + j 1.61

and Zgm = 0.0935 + j 0.7698

TABLE II
Line Impedance—Ohms per Mile

Wire Size	Z_L Calculated R + j X	Adjusted R + j X
2 Copper	1.070 + j 1.222	1.124 + j 1.283
3 "	1.318 + j 1.269	1.384 + j 1.332
4 "	1.603 + j 1.329	1.683 + j 1.395
6 "	2.420 + j 1.438	2.541 + j 1.510
2 ACSR	1.64 + j 1.32	1.72 + j 1.39
4 "	2.47 + j 1.42	2.59 + j 1.49
6 "	3.77 + j 1.52	3.96 + j 1.60
4A-CWC	1.63 + j 1.34	1.71 + j 1.41
6A "	2.48 + j 1.45	2.60 + j 1.52

TABLE III
Percentage of Line Current in Grounded Wire

Wire Size	Percentage
2 Copper	43
3 "	40
4 "	36
6 "	28
2 ACSR	36
4 "	28
6 "	19
4A-CWC	36
6A "	27

Basis of Calculation

Derivation of resistance and reactance values for multi-grounded lines must be based on a study of the flow of current through earth, and numerous studies for various limiting conditions have been made. The most useful of these studies for our purpose was reported by J. A. Carson (See formula on ensuing page).

Table I gives values of self impedance, Z_g, due to current flow in the wire itself, and the value of mutual impedance, Z_{gm}, due to current flow in the earth. These are calculated by the accompanying formulas for a few widely used conductor sizes, assuming the following circuit constants:

h—average height above ground—25 ft.

S—conductor separation—5 ft.

f—frequency—60 cycles per second.

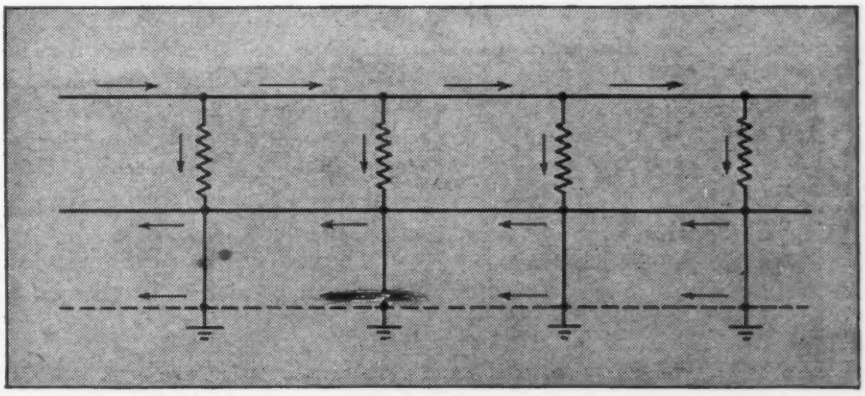
e. r.—earth resistivity—100 ohms per meter cube.

r—conductor resistance per mile.

GMR—geometric mean radius of conductor.

The effect of changing values of earth resistivity, conductor separation or stranding from the above chosen constants was checked to find the relative effect of each. Since the earth resistivity has the greatest variation,

PHASE CURRENT divides between grounded wire and ground



with values ranging from 10 for swampy ground through 1,000 for dry earth to 10^9 for sandstone, a large range in impedance might be expected. However, it was found that a 10/1 variation in resistivity produced less than a 5 percent change in the line constants, and hence the assumed value is not critical. A change in the number of strands from 1 to 7, or a change in the conductor separation from 5 ft. to 3 ft. was even less critical, being less than 1 percent in either case.

Tests Check Value

Table II shows the line impedance per mile of single-phase, multi-grounded circuit, obtained directly from the values of Z_g and Z_{gm} for single wire and earth return circuits in Table I by substitution in the formula:

$$Z_L = Z_g - \frac{Z^2_{gm}}{Z_g}$$

A large number of current ratio tests were made over a period of years. Practically simultaneous readings of phase wire current and grounded wire current were made by means of a tong-test ammeter. Voltage drop calculations based on these tests were slightly higher than voltage drops based on the calculated impedance values. Increase adjustments of 5 percent have been made in the final values of the line impedance to be on the safe side.

Division of the line current in the grounded wire and the ground is shown in Table III. These values are calculated from Z_{gm} and Z_g for each size wire.

Application of Carson's Formula

$$p = 1.713 \times 10^{-3} h \sqrt{\frac{f}{e.r.}}$$

$$P = \frac{\pi}{8} - \frac{p \cos\theta}{3\sqrt{2}} + \frac{p^2}{16}\theta \sin 2\theta + \frac{p^2 \cos 2\theta}{16}\left(0.6728 + \log_e \frac{2}{p}\right)$$

$$Q = -0.0386 + \tfrac{1}{2}\log_e \frac{2}{p} + p\frac{\cos\theta}{3\sqrt{2}}$$

$$Zg = r + j\,0.004657\, f \log_{10}\frac{2h}{GMR} + 0.004044\, f\,(P + jQ) \text{ where } \theta = 0$$

$$Zgm = j\,0.04657\, f \log_{10}\frac{\sqrt{(2h)^2 + S^2}}{S} + 0.004044\, f\,(P + jQ) \text{ where } \theta = \tan.^{-1}\frac{S}{2h}$$

(Angles in radians)

TABLE IV
Drop Factors per Circuit Mile

Copper	ACSR	CWC	90 percent pf	80 percent pf	50 percent pf
2			1.56	1.67	1.67
3			1.83	1.91	1.85
4	2	4A	2.13	2.20	2.06
6	4	6A	2.98	2.97	2.60
	6		4.26	4.13	3.37

Drop Factor Constants

To facilitate calculation, special constants or drop factors for single phase multi-grounded circuits ($R \cos\theta + X \sin\theta$) were computed for usual load power factors (Table IV). Because of the close agreement of equivalent sizes of copper, copperweld-copper and ACSR, one average drop factor was taken for each size.

Open-wye lines, two phases and a neutral, give a voltage drop very nearly equal to one-half of the drop which would be calculated over a single-phase line.

Use of the constants of Table IV in calculations of voltage drop on an extensive multi-grounded rural system for a period of four years has revealed no cases where results are in error sufficiently to necessitate any revision.

Christmas Lighting Should Be Planned Too

P. H. HILDEBRAND • Lighting Director, Pennsylvania Power & Light Co., Allentown, Pa.

FROM EXPERIENCE in erecting and operating the elaborate displays of Christmas lighting in Bethlehem and Allentown, there has been evolved a set of basic rules which, if followed, will make such displays in other communities more effective and will minimize expense and work. The most important rule is No. 10 which explains why this piece is published so far ahead of the 1947 Christmas season.

1. Be original—but still practical.

2. The colors used are a matter of choice, but do not use more than one color in a drape, loop or fixed display. Blue lamps are not very satisfactory, because of low brightness.

3. Clear lamps provide sparkle and are desirable in limited quantities.

4. The use of laurel roping or other evergreens on drapes is desirable, but make allowances for extra weight.

5. Although the C-9½ lamp is brighter and cheaper, the S-11 with a longer life and more rugged construction will prove more economical over a period of years.

6. Place displays so that they are not in competition with other bright sources. If street lights interfere, screen them with glass or plastics.

7. Cold cathode fluorescent tubing is a practical light source for Christmas lighting if properly constructed and carefully handled.

8. Check feeder sizes to keep voltage drop low and thereby maintain lamp brightness.

9. Take time to make your installations strong, sturdy and neat.

10. Make your plans early—a year before is not too soon—because Christmas lighting, like all other, should be *planned lighting*.

Power Company Plays Up Its Part In the Local Scene

From the comfortable Holoku days
dates our era of comfortable Electrical living
Honolulu danced under the banyans
CONCLUSION
The first tick-tock in Hawaii
DUCK PONDS versus progress...
POWER PUSH
.... over the Pali
Nobody will ever forget
what happened that Saturday night
in 1891
HAWAII'S ice came 'round the horn..
MIRACLES?
no, there aren't any!
Mules Found a New Freedom..
WHEN PROGRESS FOUGHT DEPRESSION
THE HAWAIIAN ELECTRIC CO., LTD.

OUTSTANDING EXAMPLE of an electric utility intelligently endeavoring to identify itself with the community it serves is the Hawaiian Electric Co. To do this the company is making consistent use of local newspaper advertisements carrying definite themes through them. One theme, partially illustrated on this page, is the history of Hawaii. Some of the advertisements in this series tell of the company's participation in the events described; in others the company's interest is indicated by associating or contrasting its modern services with them.

Another theme is "building today for tomorrow's needs," in which is presented a series of artists' concepts of public buildings, airports, seafront improvement, highway development and the like. This series has been received with widespread interest and is doing much to tie the company in with Hawaii's future in the minds of the people of this important territory of the United States.

PL means PL

YOUR lighting salesman—"The Man Who Plans"

Profitable load results from planned lighting is the bid for utility support of organized program for industry-wide promotion of modern lighting

NATION-WIDE MARKETS for modern lighting require industry-wide integration of selling effort for best results to both buyer and seller.

That was the reason for the "Planned Lighting Program" organized by the Edison Electric Institute in cooperation with the Better Light-Better Sight Bureau, and in which are coordinated the interests of electric utilities and of manufacturers of lamps and other lighting equipment. The Program will be formally unveiled Wednesday, April 2, at the spring meeting of the commercial division of the Institute in Chicago, by Joseph S. Schuchert, chairman of the commercial sales section, and Harry Restofski, chairman of the BL-BS Bureau.

According to modern standards, homes are very poorly lighted, averaging only 6 to 8 foot-candles and needing several times as much. Up to 20 million portable lamps are purchased annually and most of them are wholly inadequate from an illumination standpoint. They are bought primarily to provide light, of course, but usually that consideration is submerged when a lamp is selected, the decision resting most heavily on decorative effect.

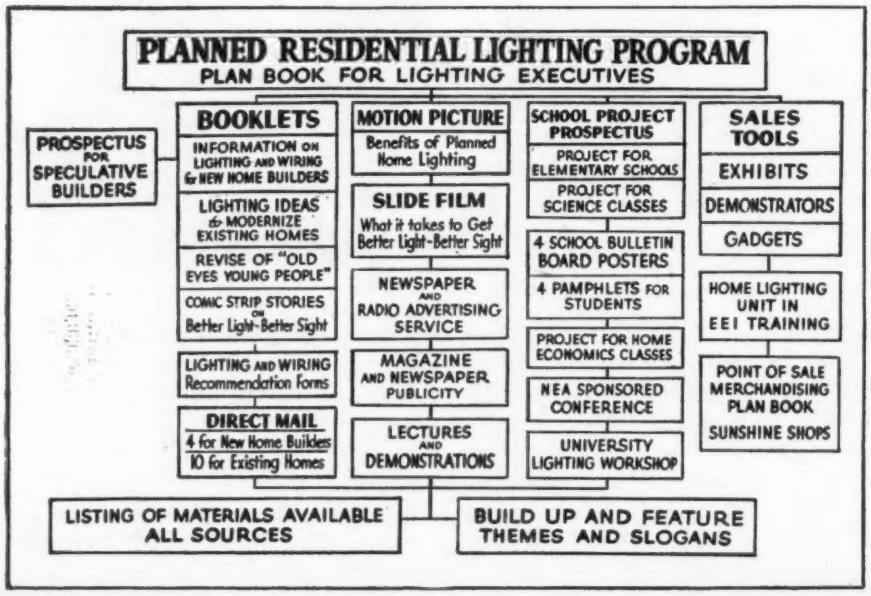
To protect the eyes of children and to facilitate comprehension of their instruction, light intensities are needed multiplying by 7 the 3 to 5 foot-candles commonly found in the nation's 285,000 schools. Surveys show that 100,000 office buildings should have 5 times their present lighting intensities. For the more efficient production demanded by post-war conditions, light intensities in 200,000 industrial plants should be increased to 4 times present levels.

Because the eye is such an amenable and accommodating organ, people are not conscious of these lighting requirements. It is the task of the electrical industry not only to supply the means for modern adequate lighting, but initially to educate users to appreciate the need for it. The educational approach is conspicuous in the "Planned Lighting Program."

The lighting load is the mainstay of electric utility revenues; it represents greater sales and revenues at lower costs for system investment and operation and for selling than any other class of service. Misapplication and insufficient utilization of modern light sources will adversely affect energy sales and revenues and will also disappoint users who have been led to expect much more than they will get. These results can be avoided by concerted effort as outlined in the Program.

Even though the present stringency in production capacity may counsel some electric utilities to go slow in developing new load, this should not prevent them from vigorous participation in the "Planned Lighting Program." Customers are not sold by one call. As stated earlier the Program is primarily educational, to persuade users to see to it that modern lighting installations are designed

MATERIAL for development of residential lighting load available in "Planned Lighting Program"


PLANNED RESIDENTIAL LIGHTING PROGRAM
PLAN BOOK FOR LIGHTING EXECUTIVES
PROSPECTUS FOR SPECULATIVE BUILDERS
BOOKLETS
INFORMATION ON LIGHTING AND WIRING for NEW HOME BUILDERS
LIGHTING IDEAS to MODERNIZE EXISTING HOMES
REVISE OF "OLD EYES YOUNG PEOPLE"
COMIC STRIP STORIES ON Better Light-Better Sight
LIGHTING AND WIRING Recommendation Forms
DIRECT MAIL
4 for New Home Builders
10 for Existing Homes
MOTION PICTURE
Benefits of Planned Home Lighting
SLIDE FILM
What it takes to Get Better Light-Better Sight
NEWSPAPER AND RADIO ADVERTISING SERVICE
MAGAZINE AND NEWSPAPER PUBLICITY
LECTURES AND DEMONSTRATIONS
SCHOOL PROJECT PROSPECTUS
PROJECT FOR ELEMENTARY SCHOOLS
PROJECT FOR SCIENCE CLASSES
4 SCHOOL BULLETIN BOARD POSTERS
4 PAMPHLETS FOR STUDENTS
PROJECT FOR HOME ECONOMICS CLASSES
NEA SPONSORED CONFERENCE
UNIVERSITY LIGHTING WORKSHOP
SALES TOOLS
EXHIBITS
DEMONSTRATORS
GADGETS
HOME LIGHTING UNIT IN EEI TRAINING
POINT OF SALE MERCHANDISING PLAN BOOK
SUNSHINE SHOPS
LISTING OF MATERIALS AVAILABLE ALL SOURCES
BUILD UP AND FEATURE THEMES AND SLOGANS

to serve their specific living, working and selling needs efficiently and economically.

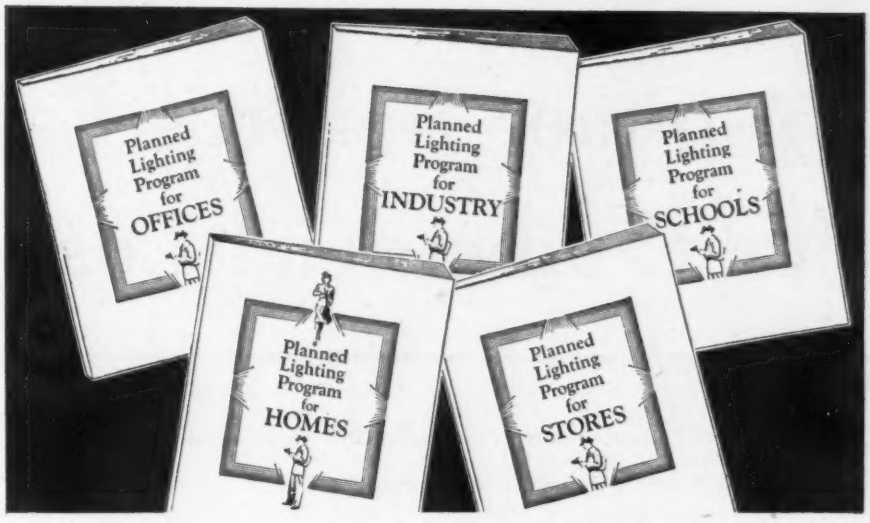
The Program as organized is most flexible and can be employed on national and local levels by manufacturers, distributors, contractors, as well as by utilities. It amounts simply to urging customers to have their new lighting planned before they buy it. And the planning can be done without cost to them.

For effective use of the Program, representatives must be adequately trained in its technical and selling aspects. Customers must be familiarized with the picture of "The Man Who Plans," the salesman whose services are always at their disposal. The utility can give effective assistance in training personnel of distributors, contractors and dealers so that they can do their part in selling planned lighting.

The Program is detailed minutely in six books. One of them is being distributed to top utility executives, carrying to them the reasons why the program is being undertaken and explaining its importance to the electric utility industry. It is supplemented, at a lower executive level, by five books dealing with the five major lighting markets—residential, stores, offices, schools and industrial.

Each of the five supporting volumes details the characteristics of the market it describes. Indications of potential revenue which may be derived through organized sales effort are included, along with the sales organization and operating methods best suited for successful selling of lighting in each of these fields. Samples of advertising and promotional material, prepared specifically for each major lighting field, also are included in each supporting volume. All promotional materials offer the free "Planned Lighting" service and enlarge the theme of the entire program —"The Man Who Plans."

The store lighting plan book attacks the problem from all sides. It presents a series of twelve direct mail pieces; a consumer booklet studded with lighting modernization ideas; a sample of the "Planned Lighting" layout form; several suggested newspaper advertisements and a sales visualizer, to arm salesmen for customer contacts.


Planned Lighting Program for OFFICES
Planned Lighting Program for INDUSTRY
Planned Lighting Program for SCHOOLS
Planned Lighting Program for HOMES
Planned Lighting Program for STORES

FIVE BOOKLETS, each covering one of the five major lighting markets, outline in detail the promotion of planned lighting

Both the new and existing home markets are the target of educational and promotional appeals in the residential "Planned Lighting" program. Aimed at the new home market are materials which include a prospectus directed at the speculative builder, a booklet explaining lighting and wiring, and a number of special direct mail pieces. For the existing home market, booklets explain numerous lighting modernization ideas. They are supplemented with an extensive series of direct mail pieces.

Other sales tools for the residential "Planned Lighting" program include exhibits, demonstrators and other types of sales helps. There is a sales training film which is tied in with the Institute's Sales Training Program. Point-of-sale merchandising material will include a plan book. From the Better Light-Better Sight Bureau there will be made available educational booklets, motion pictures, slide films, newspaper and radio advertising suggestions, lecture outlines and demonstration ideas.

The major lighting market which the "Planned Lighting" program for schools seeks to tap will feature an attempt to teach "Light and Sight" away from home. Materials for the school project will be aimed at all levels of the school population, from elementary through high school, science and home economics classes. It will include bulletins, posters, pamphlets, and other material.

Equally detailed "Planned Lighting" programs have been prepared for the major markets which offices and factories represent. The wealth of supporting materials for these programs is equal to that supplied for the store, residential and school programs. The store "Planned Lighting" program is ready for use now. The remaining four programs will be ready within a few months.

Both locally and nationally, those who attend the Chicago conference will be told, success for the "Planned Lighting" program depends upon utility commercial departments. If the 1947-48 program be successful, future comparable lighting programs, covering the entire industry, will be launched. This year's program will not encounter competition from promotional programs by major manufacturers. Instead, the entire electrical industry has joined forces on the "Planned Lighting means Profit Load" promotion.

By way of making its contribution to the industry's "Planned Lighting" program, the Better Light-Better Sight Bureau is producing a program five times larger than any previously prepared. More than 30 different lighting education aids—covering important "Light for Seeing" tasks in homes, schools, offices and factories —are designed to supply the groundwork for the sales and promotional materials which are part of the "Planned Lighting" program.

"The Bureau's program is the biggest, and its materials will be its best, because the need is the greatest," Chicago conferees will be told. " 'Better Light-Better Sight' is the foundation for lighting sales, and education is the foundation for Better Light-Better Sight. Let's go to work together on lighting education."

Customer Records Essential For Commercial Load Building

Record system for commercial customers provides maximum information with minimum clerical work . . . Report form concentrates all necessary data for any type of analysis or study from applications to territorial

RAY WARREN
Sales Analyst
Public Service Co. of Northern Illinois
Chicago, Ill.

LOAD BUILDING possibilities from small light and power applications are very promising, but there is often much room for improvement in the commercial survey and sales plans for accomplishing this objective. The plan which we have adopted after careful field testing assures that all commercial customers will be called upon in accordance with a set schedule which is based upon the customer load.

Past experiences in surveys warned us that unless the plan called for a minimum of clerical work it would die a natural death from excess costs. The sales engineer must be given the maximum amount of pertinent facts about the customer when making a personal or telephone contact, but there must also be a minimum amount of clerical work for him to perform on each call.

Record System Adopted

Visible index record files with two cards in each pocket have been set up for this plan. Addressograph plates were made for all commercial customers for inauguration of the file system.

1. A permanent file card is used for recording basic data about the customer, a control of the customer record card and for tabbing prospects and date to call. These cards are checked with the meter book and contract files for load, rate and demand data.

2. A customer record card is carried by the commercial sales engineer when he calls upon the customer. This card also shows the customer

VISIBLE Index File with permanent card for control and customer card for sales contacts has complete information for rapid review. Both sides of customer card are shown and exemplify simplicity

John Doe 168
5 W. Erie St.
Maywood, Illinois 1-2-400

COMMERCIAL RECORD CARD (ELECTRIC)

RATE	RIDER	DATE	ADDITIONAL CHARGES
21	10	12-1-4	1.05

NO. OF CALLS PER ANNUM 8.6 [x]

BUSINESS Drug Store TEL. NO. Maywood 52

USING SERVICE FOR: 1 Exterior Lighting x; 2 Interior Lighting x; 3 Sign Lighting x; 4 Exterior Lighting; 5 Street Lighting; 6 Industrial Lighting; 7 Cooking; 8 Heating; 9 Refrigeration; 10 Ventilating; 11 Air Conditioning x; 12 Power; 13 Wiring; 14 Remodeling

1945 DATE	DEMAND	KWH	NET BILL	1946 DATE	DEMAND	KWH	NET BILL	DATE	DEMAND	KWH	NET BILL
1-9	6-2	1506	5310	1-10	8.6	2790	9021				
2-8	6-0	1290	4673	2-9	8.0	2237	7662				
3-10	3-0	747	2804	3-11	6.8	1938	6612				
4-9	3-3	729	2755	4-10	6.6	2015	6785				
5-10	3-7	701	2678	5-15	8.0	2731	8301				
6-12	6-0	1645	5654	6-15	8.0	2584	8536				
7-14	6-2	1528	5370	7-14	8.4	2674	8778				
8-13	6-0	1257	4587								
9-13	6-4	1295	4767								
10-15	6-2	1510	5321								
11-10	6-0	1768	5992								
12-11	6-3	2105	6976								
TOT.		16081	56892	TOT.				TOT.			
AVER.		1340	4741	AVER.				AVER.			

WHOM TO SEE WHEN: John Doe — TITLE: Owner — TITLE:

DATE	RATE	RIDER	ADDITIONAL CHARGES	DATE	RATE	RIDER	ADDITIONAL CHARGES
12-1-4	21	10	$1.05				

1 2 3 4 5 6 7 8 9 10 11 12 13 14 JAN FEB MAR APR MAY JUNE JUL AUG SEP OCT NOV DEC

1-2-400 John Doe 5 W. Erie St. Maywood 168

REPORT EACH CONTACT

1945 DATE	PERSON CONTACTED	CODE	REMARKS	ENG'R	CALL BACK
2-1	J. Doe	1A	Interested in Air Condition Unit	JW	5-1
4-1	J. Doe	2C	High Bill-Explained to Customer-Satisfied	JW	5-1
5-1	J. Doe	1A	Sold 5 H.P. Air Condition Unit	JW	5-1
5-1	J. Doe	2C	High Bill-Explained Rate-Satisfied	JW	11-1
11-1	J. Doe	1A	Cust. Interested in Additional Lighting	JW	2-1
12-10	J. Doe	2A	Sold Additional Lighting-Interested in Ventilating	JW	2-1
1946					
2-1	J. Doe	2C	High Bill-Explained to Customer-Satisfied	JW	5-1
5-1	J. Doe	1D	Brown Out	JW	8-1

PROSPECT DATA: DATE	PROSPECT FOR	LOAD ADDED: DATE ADDED	DESCRIPTION	KW: ADDED	REPLACE	TO	RESULT: KWH	E A R
1945								
2-1	Air Conditioning	5-1	5 H.P. Air Cond. Unit	5.0	-	5.0	2400	80.00
11-1	Additional Light.	12-10	6.0K.W.	6.0	3.0	3.0	3000	150.00
1946								
2-1	Ventilating							

record data and will be kept up to date with monthly billing demand, kilowatt-hours used and amount. Space is provided for a brief report of each contact by the sales engineer, with prospects and information on load added.

A complete coding schedule of more than 100 classes of commercial and industrial uses is used by all departments to simplify the recording of information on the record cards. A commercial record log sheet is used for all reports, for individual engineers' monthly accomplishments, division summaries, and company summaries.

Daily Operation

Each day the sales clerk, under the direction of the manager, assigns cards to the commercial sales engineers to make personal calls. The engineer calls upon customers assigned and:

1. If he determines customer to be a prospect for a particular application, notes same in space provided.
2. When load is added, posts load data to card.
3. Makes brief report of call on back of card, using codes to save space. If he desires to call on customer in other than regular schedule, notes date for special call back.
4. Turns in completed cards and receives new allotment.

The clerk upon receipt of completed call cards:

1. Accumulates call data for posting to log sheet.
2. Tabs prospects listed by engineer. Provision is made on file for 14 numbers for tabbing prospects.
3. Any load reported connected is entered on engineer's spread sheet.
4. If no special call back date is indicated by engineer on card, time signal is set forward to date of next scheduled call.
5. Card is returned to file.

Since the posting of billing information for all customers billed on demand basis requires the most clerical time, we have tried as far as possible to keep visible index files in billing sequence, which is generally in geographic order.

This system as a whole has the additional advantage of permitting division or consolidation of territories with maximum information available. It concentrates all necessary data for any analysis or study that we can foresee to be necessary with a minimum of clerical work.

Hay Curing As a Load Builder

CENTRAL Vermont Public Service Corp. cultivated the hay finishing load in 1946 with increasing success, recommendations for 16 finishers being made. Farmers using this equipment agreed that they could thus produce better hay in good weather; save hay that had been rained on; and get their haying done faster.

Cooler working conditions in the haymows were noted and the fire hazard was virtually eliminated. Reports indicate that cattle will eat mow-cured hay in preference to field-cured. Spontaneous combustion cannot develop as long as the motor-driven fan is blowing air through the hay.

Malcolm E. Sergeant, of the company's farm department states that finishers are simple in design and construction; that second-hand lumber can be used for the duct system; and that power costs to the farmer seldom exceed 0.05 cent per pound of hay and decrease with rise in tonnage. The investment is not large over the long life of such a system.

As a result of experience the company's 1947 practice will call for large main tunnels as free from obstruction as possible in supplying slatted floors and slatted ducts. Openings to the slatted floor will be of maximum size and recommended air deliveries as large as practical from the economic viewpoint. To eliminate loss of air the slatted floor design will be changed to extend within 6 ft. of the outer walls rather than 3 ft. as was previously advised.

The outside end stringers will be 1 in. narrower than the others and will be blocked up 1 in. from the floor to allow a small sidewise air escape. It is desirable to taper slatted tunnels. Stringers can be spaced safely from 3 to 4 ft. apart with good lumber.

Load Values in Hay Curing

The propeller type fan continues desirable because the load on the motor varies but slightly with change in static pressure. The squirrel-cage type motor with repulsion winding of the brush riding type is favored because these maintain a more constant speed when used for other heavy duty farm jobs like silo filling and do not create as high a demand on the line when getting hard starting equipment into motion. Hay is the largest Vermont farm crop.

In one installation a check meter showed that 3,100 kw.-hr. were used in curing about 90 tons of hay, or an average of 35 kw.-hr. per ton at a cost of 70 cents per ton on the company's rate. A 5-hp. motor was used. On another farm the company estimated that 4,000 kw.-hr. would be needed to cure 60 tons of hay, the cost of energy being $1.32 per ton, and the energy use 66 kw.-hr. per ton. On two larger installations the energy consumptions were somewhat lower. Only 3,000 kw.-hr. were needed to cure 150 tons of chopped hay, or an average of 20 kw.-hr. per ton costing the farmer 40 cents per ton. Motors of 5 hp. were used on both jobs.

Hay finishers appear to be excellent load builders as the motors run continuously for several weeks during July and August. Continuous nighttime operation is an advantageous feature in the company's territory.

The company also believes that if a farmer who continues to use the old field drying method would put the hay in the barn after outdoor drying and install one of these finishers, he would have available a means of removing any excess heat which might be generated if he underestimated the water content of his hay. This would call for a less expensive installation than mow finishing from the field without outdoor drying, and would be insurance against spontaneous combustion.

Bank of Capacitors Reinforces 132-Kv. Grid

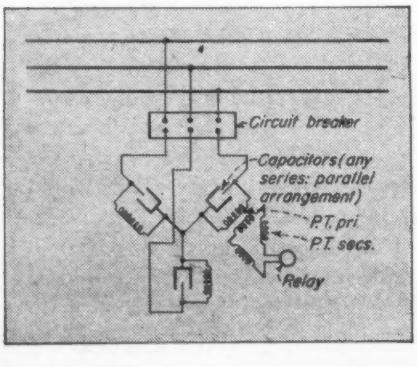
L. F. FERRI • Electrical Engineer, Ohio Public Service Co., Elyria, Ohio, and
C. S. DAYTON • Transformer Specialist, General Electric Co., Philadelphia, Pa.

Battery of 720 of the 15-kvar. units on 12.7-kv. bus averted second transformer bank—Coordinated protective scheme chosen after consideration of several alternatives

DURING the war years when the demand for electrical power multiplied almost over night, the capacitor with its relatively low initial cost and flexibility proved one of the best solutions to make increased power available at short notice with existing transmission facilities.

The Ohio Public Service Co. serves communities in northeastern and northern Ohio. While the wheels of the war industries in the area turned at top speed, certain points of the transmission system had to be reinforced quickly, with minimum utilization of vital material and labor. Sandusky with peak demand of 28,200 kw. and 14,800 kvar. is supplied by two 132-kv. lines. The point of supply is, however, the low point of the 132-kv. grid. Although the step-down transformer bank is equipped with a tap changer for operation under load which has a plus and minus 10 percent regulating band, it was found that during peak demand desired voltage on the 34-kv. bus could not be maintained. After careful analysis of the cost of purchase of the second transformer bank and necessary switching equipment on one hand and a capacitor bank on the other hand, the latter installation proved to be more advantageous. In this decision we were guided by the possibility that after the war some of the industries serving purely war needs and consuming the bulk of the increased power would be shut down and the second transformer bank become superfluous for several years, whereas the capacitor bank could be broken down into smaller units and fully utilized again at various parts of the distribution system.

FIG. 1 — Wye-broken-delta potential transformer scheme has relay across the broken delta



The purpose of this article is to describe briefly the physical characteristics of the installation, to point out that there are several methods of protection for large capacitor banks, to discuss these methods and to explain why one of these methods was considered best and, therefore, selected.

The Capacitor Equipment

The capacitor bank is rated 10,800 kvar., 12,470 volts, 3 phase, 60 cycles. It is connected through an oil circuit breaker to the tertiary winding of the 132-kv./34-kv., 33,333-kva. step-down transformer bank. The size of the tertiary winding limited the size of the capacitor bank. The bank (Fig. 2) itself consists of the standard 15-kvar., 2,400-volt outdoor distribution capacitor units in open type structures. Selection of the open type structure was made for the following reasons:

1. The installation of this particular capacitor bank as mentioned above was considered temporary, which dictated that for maximum flexibility the individual units must be outdoor type and rated at a distribution voltage.

2. In this case the open type equipment resulted in a slightly lower first cost than the special housed equipment mounting outdoor 2,400-volt capacitor units series-connected, with proper insulation to ground. Also it was felt that the salvage value of the open structures might be greater than that of the special housed equipments.

Four Equal Sections

The capacitor bank is divided into four equal sections of 2,700 kvar. each, connected to the main bus through hook-stick operated disconnecting switches. These switches may be operated when the capacitor bank is deenergized to vary the amount of the reactive kva. supplied to the system. The switching of capacitors in blocks was not considered necessary as the tap changer under load provides for a precise control of the

34-kv. bus voltage. Bushing-mounted fuses will remove individual capacitor units in the event of difficulty in the unit and the relay protection described in more detail later gives over-all protection against internal and external faults. Because three groups of units are in series across each leg of the wye and the neutral is allowed to float, the individual fuses have very little current to clear and their operation will cause no system disturbances.

Capacitor Connections

Each 2,700-kvar. bank consists of 180 capacitor units rated at 15 kvar., 2,400 volts, 3 phase and 60 cycles. Twenty units are connected in parallel and three such groups are connected in series to make up a phase to neutral assembly. Each tier of the 2,700-kvar. structure then becomes one phase and its supporting frame is isolated from the grounded structure by pedestal type insulators. Since all capacitor cases in one phase are solidly connected together, they are all at the same potential and float midway between the line and neutral, thus allowing the use of standard 2,400-volt units insulated for 5-kv. terminals to case. Lightning protection is provided by station type Thyrite arresters mounted on top of the first structure (see Fig. 2).

The Protective Equipment

Very careful consideration was given to the selection of a protective scheme. First of all, the entire bank is protected against over-voltage. The induction type over-voltage relay located at the main panelboard sounds an alarm if the 10 percent over-voltage set as permissible limit for the capacitor has been reached. In this case, the entire bank is switched off manually. Experience has demonstrated that during normal week days the capacitor need never be switched off due to over-voltage. In addition to the over-voltage protection, the breaker is equipped with instantaneous over-current relays. These relays actually protect the transformer bank against a short circuit in the underground cable and in the open bus work of the capacitor bank. Also experience in switching large capacitor banks has proved that inrush-current bypass reactors around the plunger type instantaneous relays are not needed and, therefore, these reactors were omitted in this installation.

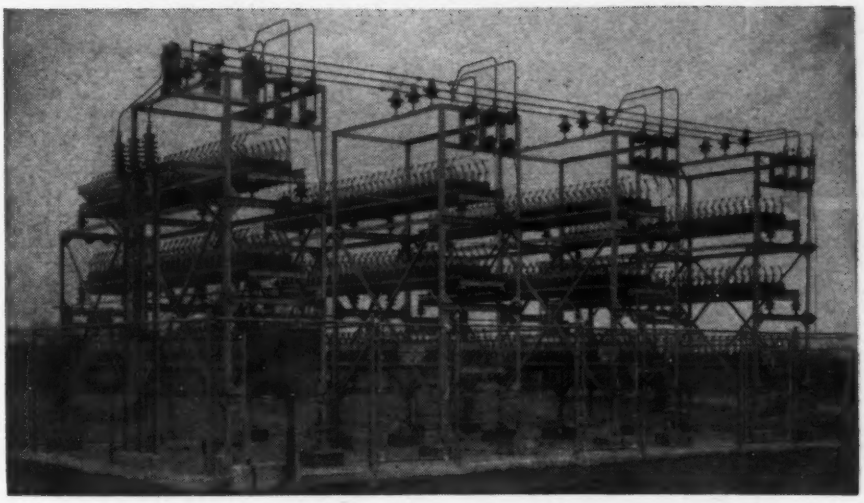


FIG. 2—Capacitor bank of 10,800 kvar. (12 kv.) at Sandusky substation. At left cable connects (200 ft.) underground to switchyard, thence to transformer bank tertiary. Control switch of oil circuit breaker, indicating instruments, over-voltage and three instantaneous overcurrent relays are on main panel board of the substation building some 300 ft. from the capacitor bank

For over-all protection of the capacitor equipment, the scheme using relays in addition to the individual fuses was preferred. Relay protection alone without the fuses was ruled out because the failure of one 15-kvar. unit could cause the removal of the whole bank from the system and would result in an outage of the entire 10,800-kvar. bank until the difficulty could be located and remedied.

Two schemes of relaying were considered:

A. The wye-broken-delta potential transformer arrangement consists of potential transformers connected line to neutral and a relay connected across the broken delta of the transformer secondaries (Fig. 1). A predetermined amount of unbalance in the bank will cause current to flow through the relay and trip the oil circuit breaker to deenergize the bank.

B. A potential or current transformer can be connected in the neutral between halves of a capacitor bank to detect unbalance and to operate a relay to trip the breaker and to deenergize the bank. (Fig. 3)

Comparison of Protective Schemes

Protective schemes A and B, each in conjunction with individual fusing, were considered from the following standpoints:

1. Protection.

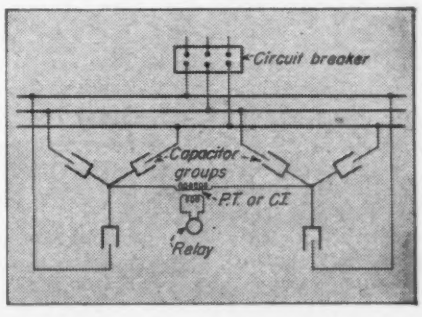
Either protective scheme, by itself, will theoretically give the same degree of protection. By selection of proper time setting of the relays, the faulty capacitor unit can be made to bulge slightly so as to be easily detected, but the case not allowed to rupture. The practicability of this time setting has been demonstrated in actual practice. However, since it was decided to use both fuses and over-all relay protection, the compatibility of the two must be considered during actual operating conditions.

2. Operation.

Using relay Protective Scheme A and individual fuses, two methods of operation were considered:

a. Failure of one capacitor unit should be taken care of by its individual fuse: and over-voltage on remaining units would not be serious; therefore, inverse time relays should be set to overlook or to be inoperative during the clearing time of a fuse. However, further difficulty must be

FIG. 3 — Potential or current transformer connected between halves of a capacitor bank to operate protective relay to trip breaker



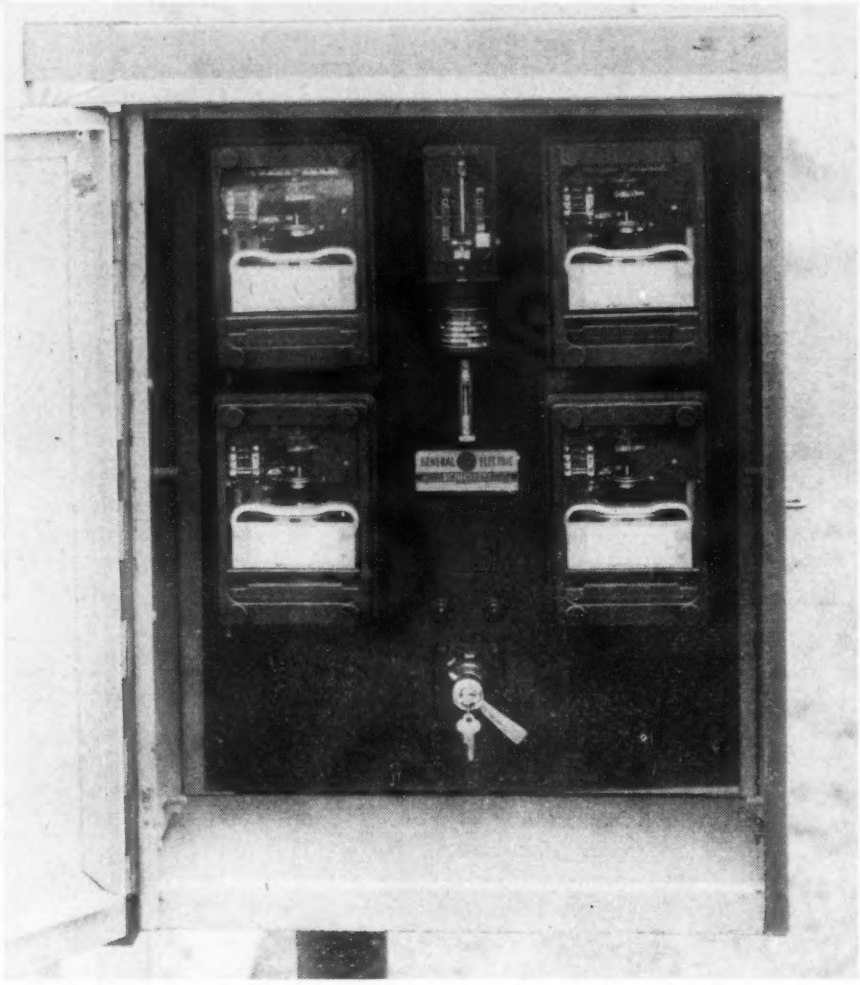


FIG. 4—Four induction-type, time-delay overload relays and one hand-reset plunger-type tripping relay and permissive control switch comprise the protective equipment

detected by the relaying system. Since the relays will not operate during the clearing time of the fuse, they must detect unbalance *after* a fuse has cleared and with three capacitors in series and 20 in parallel across each phase to neutral, the voltage change in the broken delta of the transformer secondaries is small and difficult to detect with the standard over-voltage relays. Perhaps the relay would only operate in the event of major difficulty such as flash-over or failure of several units.

b. Instantaneous relays can be used that will pick-up *during* the clearing time of the fuse and lock in to sound an alarm or to give a signal, but not trip the breaker. If inspection indicates that the difficulty is minor (one fuse blown), the relay can be reset and operation continued. If instantaneous relays are used to trip the breaker, the fuse will not clear and there will be no indication of the faulty unit.

Using relay Protective Scheme B together with individual fuses, two similar methods of operation were considered:

a. Failure of one capacitor unit should be taken care of by its individual fuse and voltage on remaining units not regarded serious. The inverse time relays should be set to be unoperative during the clearing time of a fuse. With 1/1 ratio current transformer, a low energy type over-current relay can be set to overlook neutral current flow during clearing time of a fuse and after one fuse has blown, but will detect any further unbalance and trip the breaker.

b. Instantaneous relays can be used that will pickup during the clearing time of the fuse and lock in to sound an alarm or to give a signal, but not trip the breaker. If inspection indicates that the difficulty is minor (one fuse blown), the relay can be reset manually and operation continued. If instantaneous relays are used to trip the breaker, the fuse will not clear and there will be no indication of the faulty unit.

3. Cost.

Both relay schemes are inexpensive in relation to the cost of the total bank. In general, since only one transformer is needed for each bank using Scheme B as compared with three for Scheme A, a cost advantage results for Scheme B.

Selection of Protective Scheme

After considering the three points of comparison (protection, operation and cost), as outlined above, the following conclusions were made:

1. Scheme A has the advantage of more units in parallel since the groups are not subdivided. This means less increase in voltage in the remaining capacitors after the fuse of one unit has cleared the unit. However, since the ability of this system to detect accurately the unbalance after the fuse has cleared is questionable, the relay would have to pick up before the fuse clears and then have the fuse clear simultaneously with the opening of the breaker. This precise coordination between fuse and relay would be difficult to accomplish and, therefore, it was felt that this scheme is best suited for use without individual fuses.

2. Scheme B was considered to be more compatible with fuses and to offer greater flexibility in operation. Scheme B was, therefore, selected.

Details of Protection

The relay equipment mounted in a cabinet outside the enclosing fence of the bank can be seen in Fig. 2, and one current transformer is mounted on the rear of each structure. Fig. 4 shows the arrangement inside the cabinet. The devices consist of four induction type, time delay, overload relays (one for each bank) with target indicators, one hand reset plunger type tripping relay and a permissive control switch with red and green indicating lamps. If any one of the over-current relays pickup, it will actuate the tripping relay which in turn trips the breaker. The hand reset feature of the tripping relay prevents the inadvertent closing of the bank without the inspection of the equipment and the resetting of the tripping relay. The permissive control switch

is a safety feature which, when placed in "trip" position, prevents the breaker from being closed from the main panel while the inspection is being made on the capacitor.

The purpose of mounting the relays for internal protection in an outdoor cabinet near the capacitor bank and not on the main panel board at the control building is two fold: operating convenience and economy. From operating point of view, it is considered advantageous to have the relays near the capacitor bank because any operation of these relays demands visual inspection of the units. This location also reduced the cost of installation because it eliminated the long runs of control cables from the capacitor bank to the control building, a distance of 300 ft.

Relay Settings

At the present time, advantage is not being taken of the ability of this protective scheme to overlook failure of one unit, but function for any further difficulty. The low energy time delay current relays are set for 0.8 amperes and lever setting of 3. With this setting the relays will detect the fault in one capacitor unit (see calculations) and will trip the breaker, but not until *after* the fuse protecting the unit has cleared the unit. The blown fuse serves as means of detecting the defective unit. The defective capacitor unit in any of the groups, therefore, will remove the entire bank for a short period until the faulty section can be disconnected. The bank with reduced capacity ($\frac{3}{4}$ to full capacity) could be switched on the line again.

During the first year of operation the capacitor relayed out only once due to mechanical breakage of one of the fuse links. This operation was as expected.

Calculations of Neutral Current

To select the current transformer for Scheme B and to provide for proper setting of the relay, it is necessary to calculate the neutral current flow for various conditions. Let us consider the condition of one fuse cleared and, therefore, one unit removed from the circuit.

Referring to Fig. 3, a phase with all capacitors energized consists of 30 units with three series groups of ten units in parallel in each group, while the phase with a faulted unit has one group with only nine units in parallel. Each 15-kvar. 2,400-volt unit is rated 384 ohms.

$$\text{10 units in par.} = \frac{384}{10} = 38.4 \text{ ohms}$$

$$\text{9 units in par.} = \frac{384}{9} = 42.7 \text{ ohms}$$

Ohms at fault phase = $38.4 + 38.4 + 42.7 = 119.5$

Ohms of other phases = $38.4 + 38.4 + 38.4 = 115.2$

By the use of Alpha, Beta and Zero components, (See Chapter X "Circuit Analysis of A.C. Power System," Volume I, Clarke)

$$I_A = \frac{3/2\ E}{Z_A + Z_B/2}$$

I_A = Amp. in fault phase
E = Normal line-to-neutral voltage
Z_A = Ohms faulted phase
Z_B = Ohms either remaining phase

Substituting

$$\text{Current through fault phase} = \frac{3/2(7200)}{119.5 + 115.2/2} = 61 \text{ amp.}$$

Voltage across fault phase = $119.5 \times 61 = 7290$ volts

Then by Thevenin's Theorum, the external voltages can be removed and the current in the neutral will be equal to the open circuit voltage divided by the total impedance.

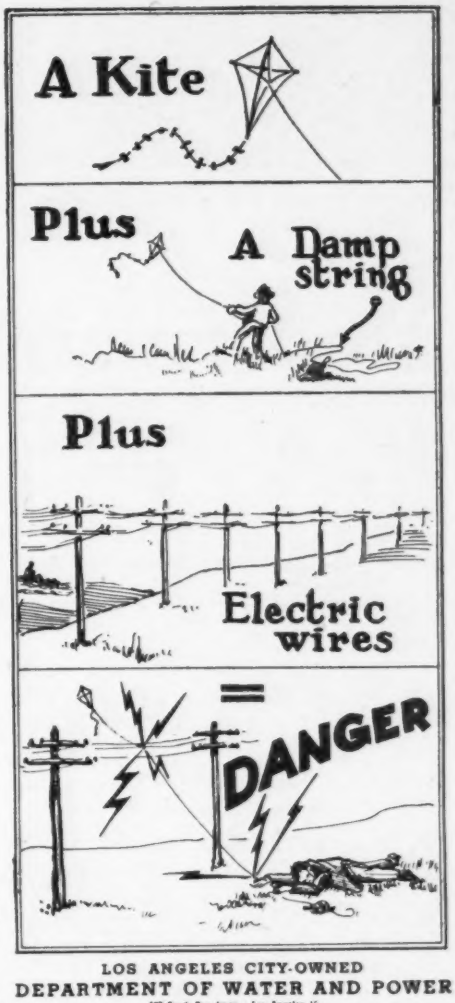
Open circuit voltage between neutrals $7{,}290 - 7{,}200 = 90$ volts.

$$\text{Total impedance} = \frac{115.2 \times 234.7}{115.2 + 234.7} = 77.3 \text{ ohms}$$

$$\text{Current in neutral} = \frac{90}{77.3} = 1.16 \text{ amp.}$$

Secondary current through relay (Current transformer ratio 1/1) = 1.16 amp. Relay set for 0.8 amp. and No. 3 lever setting.

An Easy Lesson in Arithmetic



LOS ANGELES CITY-OWNED
DEPARTMENT OF WATER AND POWER
207 South Broadway • Los Angeles 12

Kites and Arithmetic

ESPECIALLY effective during last spring's kite week was the handbill illustrated issued by the Department of Water & Power of Los Angeles to warn school children of the dangers of kite flying. Boys in the elementary grades were attracted by the arithmetic approach. Distribution was made by the Playground Commission through all public and parochial schools. A movie is planned by the Department for showing this year during kite week.

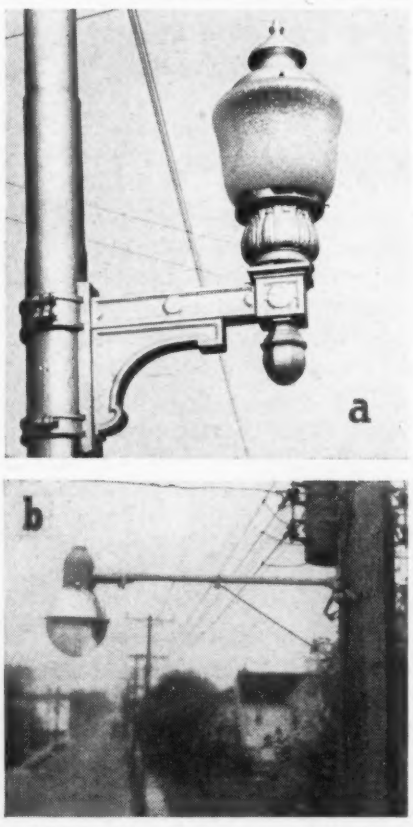
SOUTH BROAD STREET, Penns Grove, N. J., before and after modern lighting was installed

Modernizing Street Lighting In A Small Town

J. J. TYNAN
Street and Highway
Lighting Representative
Atlantic City Electric Co.
Atlantic City, N. J.

SUCCESS in selling modern street lighting in small towns requires perception of the outstanding lighting problem of the particular community, analysis of that problem, and practical suggestion for its solution, all presented in convincing fashion to the city fathers. Also required is recognition of the usual condition that the makers of small town municipal budgets realize that pennies add up to dollars pretty fast. Thus an acceptable proposal for street lighting improvement must be modest in cost and give the utmost possible for the money expended. As an example, let us look at Penns Grove, N. J.

The Borough of Penns Grove, population 9,000, is situated in southern New Jersey, just across the Delaware River from Wilmington, Del., on routes U. S. 40 and N. J. 48. The outstanding street lighting problem of this particular town arose out of its location, out of the very thing that does much to make it a thriving and prosperous community. Through Penns Grove flows a heavy and continuous traffic—produce trucking from the Southern States to the New York area markets and southward movement of manufactured goods; plus, in the summer, a large volume of tourist traffic to and from New Jersey shore resorts. The streets on which this traffic moves are relatively narrow, averaging about 33 ft. This fact, which is a disadvantage in respect of vehicle movement, was grasped as an advantage in design of the new street lighting.



Old (a) and new (b) types of luminaires

The borough officials, although recognizing that the street lighting was decidedly sub-standard and left much to be desired, were reluctant to do anything in the way of improvement, fearing that the cost of increased operation would be too high.

It was brought out during a series of discussions with the Electric company engineers that more illumination on the transverse sections of the street could be provided by luminaires with 6,000-lumen lamps than was possible with the 10,000-lumen lamps of the boulevard-type units which were installed along some blocks in the town. Final and favorable decision rested on the merits of a trial installation.

The Electric company offered to relight two full city blocks in the downtown section at no cost to the borough, to prove to the city officials what could be done with new type street lighting equipment. Permission

was asked for and readily given to put on the trial installation.

The trial installation here, as in several other communities, did more to gain endorsement than any persuasive argument that could be offered. Following the trial installation, it was not long before the borough's order to proceed quickly with the relighting of its two main streets was received.

Several types of luminaires were installed on the two main streets, many of them of the handsome boulevard kind popular some years back, sticking up on cast-iron ornamental brackets attached to poles. These units, containing 10,000-lumen lamps and mounted 14 to 15 ft. high in staggered arrangement along the street, did a much better job of lighting the sky above than the street below. Their efficiency was about 13 percent. Other existing luminaires were of more modern design but their application efficiency was low, mainly because they had been installed when, as and if and were not combined in a coherent engineered plan of illumination. One of the accompanying pictures shows the condition.

Turning the narrow street traffic disadvantage into a lighting advantage, the modern lighting system was designed to use the new acorn-shape luminaires with asymmetric glassware and 6,000-lumen lamps, suspended on 4-ft. brackets attached to standing distribution poles along only one side of the street. This made a very economical installation. With spacing averaging about 100 ft. and 25-ft. mounting heights, the calculated intensity averages 0.8 foot-candles. Because of the high mounting of the luminaires, the comparatively short brackets are perfectly adequate for uniform illumination of the 33-ft. streets.

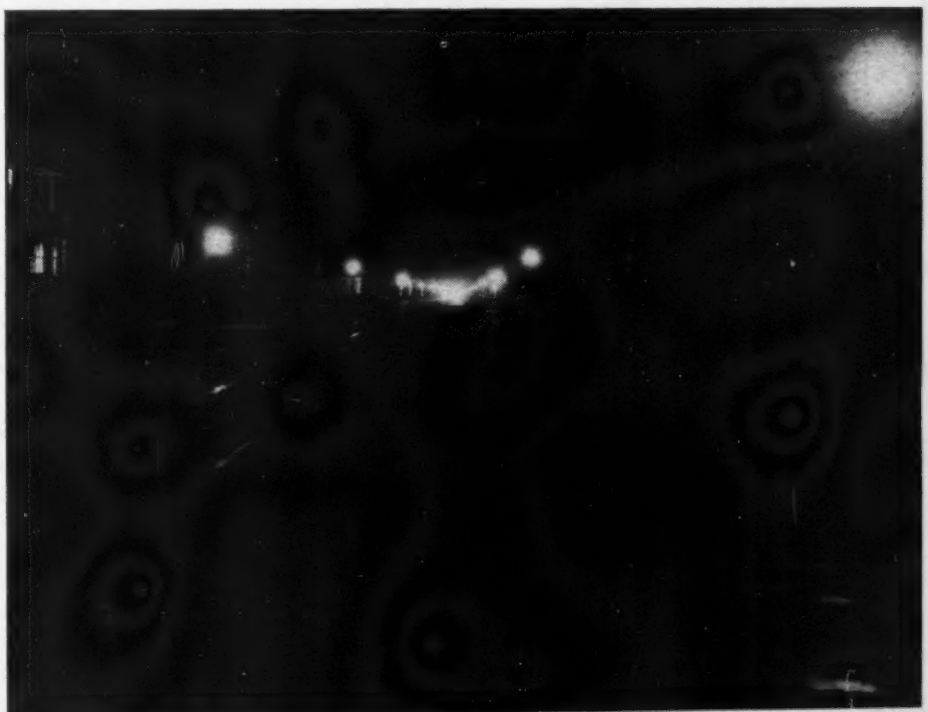
Under the old lighting only about 30,500 lumens, out of a total of 225,000 supplied, were actually delivered to the driving lanes, an application efficiency of less than 14 percent realized. The efficiency of the new system is 39 percent, 140,000 lumens to the street out of 360,000 supplied. Thus, Penns Grove is getting over 4.59 times the light that it had before on its two heavy traffic streets.

Heavy through traffic presents serious problem to small community—Modern traffic safety improves night driving illumination 359 percent at a cost increase of only 13

The cost? According to an editorial in the *Penns Grove Record*, the local weekly, the annual cost of street lighting to the borough is now $11,865 and it was $10,500 before. That's a cost increase of 13 percent, for which an increase in effective lighting of 359 percent is obtained. Speaking of the satisfaction of the people with the new lighting the *Record* editorial ends with these words:

"It all comes in the march of progress, and it is these little things that count a lot when attacked intelligently by borough officials with the help of the utility company, aided by scientific study of the use of artificial lighting."

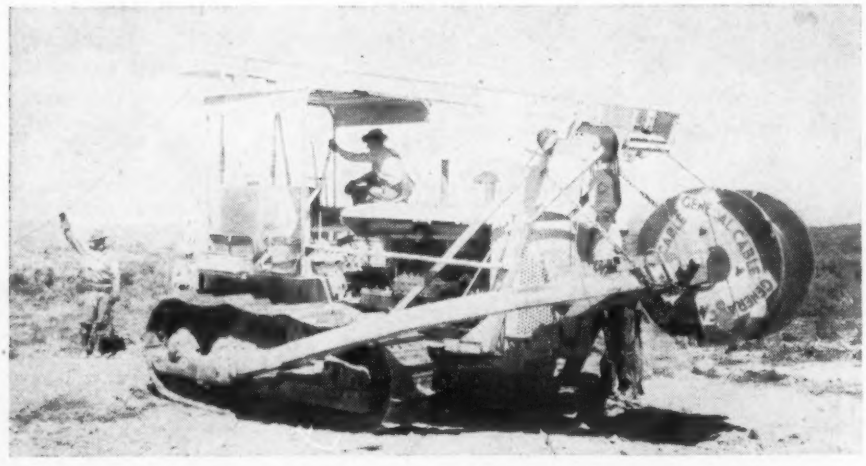
And in Margate City, the municipal fathers did not want to spend the money to rehabilitate the deteriorated street lighting system. So they contracted with the Atlantic City Electric Co. to supply full street lighting service, with the result that appears in these "before" and "after" pictures



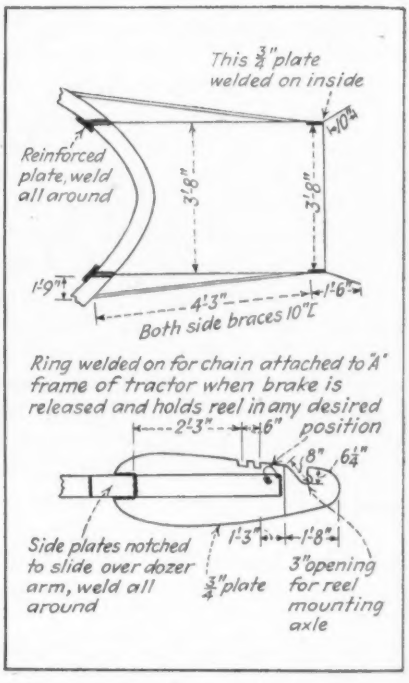
HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Bulldozer Arms Carry Cable Reel



BULLDOZER FRAME with cable reel utilized in Idaho line construction.



REEL mounting attachment to bulldozer

STRINGING of conductors on a section of the 130-mile Idaho Power Co. transmission line running between Emmett and Hagerman, Idaho, was facilitated by use of a diesel-operated tractor with bulldozer frame redesigned to carry a cable reel.

The Caterpillar tractor was operated in the vicinity of Mountain Home, Idaho. Line construction time was reduced by 13 percent despite the fact the terrain is very rough and irregular, having lava rock outcroppings and several canyon crossings. Much of the construction was done when very muddy conditions prevailed.

The line consists of three 250,000-cir.mil conductors. It was constructed by Morrison-Knudsen Co., Inc., Boise, in whose shop supports for the cable reel were mounted on the bulldozer arm. Accompanying sketch illustrates the reel mounting. By the design the reel mount could be removed and the dozer attached as it was often required on steep hillsides.

The tractor was used to pay out the conductor as it traveled along the line. Two logger drums were attached to the rear of the tractor, each containing 2,000 ft. of ⅜-in. Lang Lay steel cable; one used as a pull line, the other as a tail line. By this arrangement a 2,000- to 3,000-ft. span across canyons could be completed in approximately 10 hr. Dynamometers were connected to the tractors and in series with a long chain hoist and the conductors. The tractor would be moved forward to pull the surplus slack. The chain hoist would equalize and sag to the required tension, which previously required a small force of linemen. Using this method two miles of line were strung and sagged per day in very rough terrain and mud where only a tractor could travel.

• • •

Adjustable Burners Regulate Temperature of Superheat

SPREAD of superheat temperature with load changes experienced with either damper or desuperheater control can be greatly reduced by resort to tilting burners, according to information given in a recent A.S.M.E. paper by Otto de Lorenzi, Combustion Engineering Co. The desired results are obtained by optimum positioning of the turbulence in the furnace and the resulting heat absorption and furnace exit temperatures. A bypass damper is then relied upon to provide the final incremental adjustment of steam temperature. This advantage of constant superheat temperature is accompanied by lessened tendency for slag accumulation.

Confirmation was obtained from a 525,000-lb. per hour steam generator operating at 875 psi. and equipped with burners at the corners capable of tilting 24 deg. above and below the horizontal. Furnace temperature to produce 900 F. steam at rated output was under 2,100 F., lower than the ash fusion temperature, the burners

being set 24 deg. below horizontal. For light load of 260,000 lb. per hour the burners are tilted up to raise the zone of turbulence, reduce the heat absorption in the furnace and hold the desired 900 F. temperature.

Tests on a 600,000-lb. per hour, 875-psi. unit showed ability to hold 900 F. with less than 5 deg. variation from ⅓ to full load. The bypass damper was used only to supply regulation automatically between selected burner positions and compensate for fluctuations arising from fluctuations in fuel supply or in feedwater temperature. Pushbutton control is provided for the operation of tilting the burner to the desired position.

• • •

An ELECTRICAL WORLD *Comparison of Service Practices . . .*

I—Service Rules and Information Made Available to Customers

EVERY electric utility has certain rules and regulations governing the service conditions and connections at the entrance to its customers' wiring. Some standard arrangements are necessary for meter installation, and some requirements are essential to the safety of electric service. Limits must be placed on the loads that may be connected to particular classes of service and protection against overloading is essential to both continuity and quality of the service.

Some general regulations are, of course, a necessary part of company rate schedules. Classes and voltages of service available, the point of connection between company distribution and customer wiring and a statement of responsibility are included. It is in the information and details beyond these formal statements that booklets or sheets for general distribution may be most useful.

Booklets Most Widely Used

A majority of the larger companies have printed copies of their service information and requirements which may be given to customers and wiring contractors, and the most popular form for distribution is a pocket-size booklet. Each of the companies represented in the accompanying tabulations has 100,000 meters or more. In many smaller organizations no formal or written sheets are considered necessary. Here, as in two of the larger companies also, letters and drawings or close personal contacts have been sufficient to maintain the essential arrangements.

Complete Information Included

Four principal sections, as shown in the accompanying outline, are included in most of the booklets reviewed. In a few cases, these principal sections are subdivided or rearranged to group the services under types of service headings, as resi-

Practices Compared

IT IS NATURAL to want to know how "the other fellow" has been doing something you are setting out to do. It is more than curiosity—it is a desire to avoid errors by emulating proven results of others. ELECTRICAL WORLD ***editors are compiling and analyzing the procedures of representative utilities and will present the results in terms of the trends and the distinctive departures. The present series on service rules will be followed immediately by a series on estimating transformer loads and diversities.***

Rules and Service Information of 26 Companies

4 Revised and issued—1946
10 Were issued 1941-43
3 Were issued 1937-38
2 "Obsolete"—to be revised
5 Revisions now in draft form
2 Have no printed rules

Of the 19 in printed form—

15 Are in pocket-size booklet form
1 Booklet is loose-leaf
3 Are printed on letter-size sheets

Contents of Service Books

Systems and Classes of Service Available
Voltages, single-phase, three-phase

Service Connections
Location of entrance, overhead, underground, grounding, transformer vaults

Meter Installations
Meter, switch and fuse requirements, location, connections

Customer Utilization Equipment
Wiring. Motors and control, starting currents. Large appliances. Special apparatus

Drawings and Illustrations

3—Have no drawings
3—Have 3 to 5 drawings
1—Also has 10 illustrations
3—Have 9 or 10 drawings
7—Have 15 to 20 drawings
4—Also have 10-11 illustrations
3—Have 23 to 26 drawings.

Composite Statement of Purpose of Rule and Information Booklets

THIS BOOKLET is issued by the Company in the interest of good electric service, to acquaint its customers with points relating to installation of services, metering, and wiring and as a convenient reference for contractors, architects and engineers in planning connections to the distribution system of the Company. It is also intended as a guide for employees of the Company who assist customers in arranging their service and metering installations.

dence, rural, commercial and industrial.

Larger companies particularly refer to the several departments having contacts with the customers. Services of the company which are available through the sales or commercial department, and the service or distribution departments are mentioned. Locations of application offices and of service district headquarters are listed in about half of the booklets.

Drawings of service entrances and meter installations and some other details are included in all except three of the printed booklets. Separate drawing sheets are used by some companies without printed books, and also to supplement the books in a number of cases. Pictures of installations are used in only five of the booklets, although more use appears justified by the help which they give in understanding good practices. Several companies have pamphlets for details of water heater and range service and wiring installations.

A few of the service booklets call particular attention to the need for adequate wiring and facilities beyond the minimum safety requirements. More of the companies refer to their arrangements to assist customers in planning wiring and appliance installations. Four booklets contain some suggested wiring layouts or tables.

Details of service requirements and starting currents permitted will be compared in subsequent articles.

• • •

Magnesium Anode Protection of Transformer Tanks . . . I*

L. J. GORMAN • Assistant Engineer, Consolidated Edison Co. of New York, Inc.

IN RECENT YEARS, there has been considerable interest in the use of electronegative (anodic) metals, such as aluminum, magnesium and zinc, for the cathodic protection of metallic structures which are subjected to electrolytic corrosion in a soil, or water, environment.

Cathodic protection of underground structures is based on the principle of maintaining the protected structure cathodic with respect to its immediate environment and thus neutralizing the action of the local electrolytic cells which normally exist on the metal surface. The cathodic effect is obtained by causing an electric current to flow from the soil to the metal. For this purpose, auxiliary electrodes, suitably located, are connected to the protected structure through a source of direct current. The required current is usually supplied by a rectifier or other suitable source. However, under certain limited conditions, the metals listed above can be used as the source of current through the galvanic cell arrangement.

The electrode potentials of aluminum, magnesium and zinc are considerably higher than the potential of iron, and they constitute a source of electric energy which may be used for the cathodic protection of the more noble metal. For example, when iron and magnesium are buried in the soil, or immersed in a weak saline solution, the potential difference between the two metals amounts to, approximately, 1.0 volt. Under similar conditions, the potential difference between iron and aluminum is 0.7 volt, and the iron-to-zinc potential is 0.45 volt (approximate values). In each case the iron is the cathode and the other metal is the anode. When electrically connected, an electric current flows through the electrolyte (moist soil or water), from the anode to the cathode. The anode metal corrodes; and the iron cathode is protected at the expense of the anode. The magnitude of the current will depend upon the open circuit potential, the circuit resistance, polarization effects and other controlling factors. This is substantially the action which occurs when an anode metal is used for cathodic protection of a more noble metal.

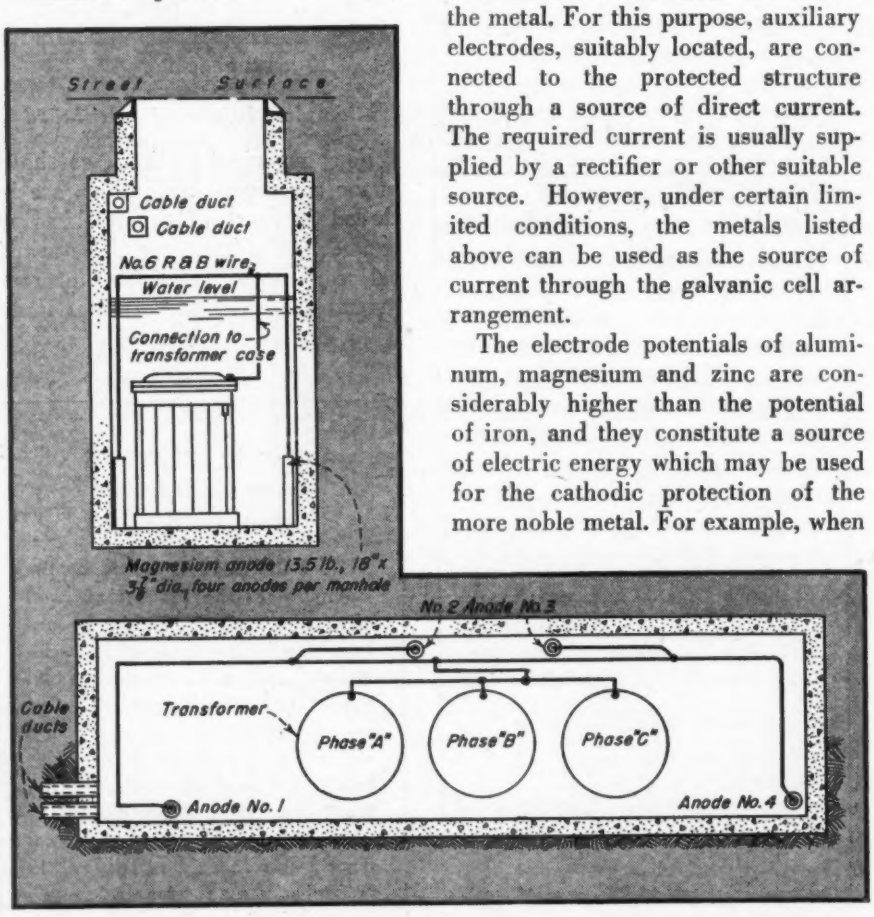


FIG. 1—Magnesium anode locations and connections for cathodic protection of three distribution manhole transformers. (Primary and secondary power cables not shown)

Anode Selection

In selecting an anode metal the decision will depend upon numerous factors which relate to various electrical, chemical and economic considerations.

Magnesium has been used as an anode metal for cathodic protection of transformer tanks. The electrode arrangement and connections are shown in Fig. 1. Results and operating data covering a period of almost ten months will be outlined in an ensuing issue.

* Beginning a series of three articles. Illustrations are numbered in sequence throughout the series.

KILOVAR ECONOMICS #2

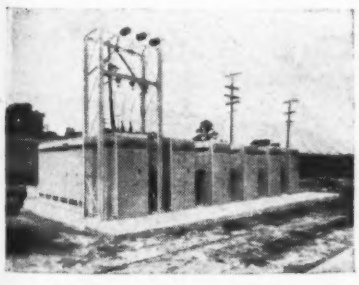
Johnny says:

With load increases eating into reserve carrying capacity—and with costs of both fuel and equipment going up—*the losses caused by kilovars are now more costly than ever before?*

Energy losses due to kilovar transportation can actually exceed 1/5 of your domestic load. Reducing these losses by supplying on-the-spot kilovars from capacitors offers exceptional savings and advantages today, for these reasons:

1. Capacitors are now low in cost—less than $10 per kilovar installed.
2. Increased system capacity is made available immediately, as soon as on-the-spot kilovars are supplied.

That is the dollars and cents side of the story. Important system improvements also result. Voltage drops throughout the system are reduced. More kilowatts per ampere can be delivered. Distribution circuits are cleared for carrying increased pay load.



Your General Electric representative will be glad to explain in further detail the specific advantages of applying capacitors to *your* system. Or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

LOTS OF COMPANIES ARE DOING IT NOW!

There are 8 million kilovars of capacity installed throughout the country. Typical of the companies now taking advantage of on-the-spot kilovar generation are Oklahoma Gas and Electric Company, with capacitors equal to 20 per cent of their peak load; Public Service Company of Northern Illinois—10%; Public Service Electric and Gas Company—16%; Illinois Power Company—18%. Why not use capacitors as an economic tool in *your* system planning.

*It's a matter of simple arithmetic

1. Total energy losses generally approximate your domestic load.
2. Ratio of copper losses to total energy losses approximate 50%.
3. At 80% Power Factor, 60% kilovars are flowing.
4. The % of copper losses due to transporting kilovars is therefore $\frac{(60)^2}{(100)} = 36\%$.
5. Therefore 36% of 50% equals 18% (or, in round numbers, 1/5 of your domestic load).

GENERAL ELECTRIC

407-113-5700

Design Chart for Distribution

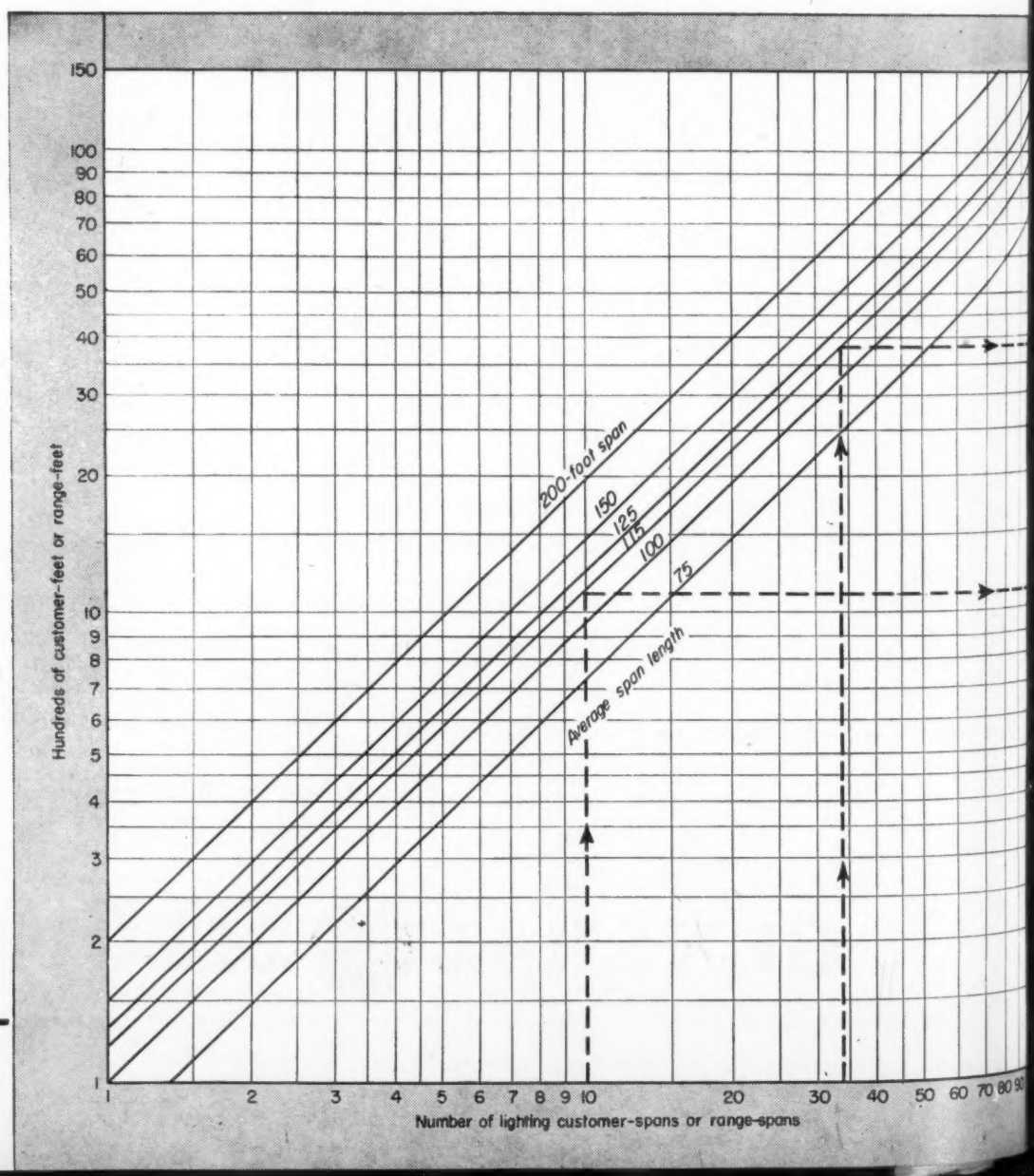
Chart determines voltage drop in 3-wire, 120/240-volt, secondary circuits supplying both lighting and range customers—for given values of wire size, span length and numbers of customers and ranges

Example . . . Assume 20 lighting customers and six ranges fed one direction from transformer totaling 34 lighting customers' spans and ten-range spans. Average span length of 115 ft., wire size No. 3.

Begin at lower left of chart at 34 lighting customer spans and follow dotted line vertically to 115-ft. span curve, then right to 20 lighting customer curve, then vertically to wire size, then right to voltage drop (0.8 percent).

Begin with ten-range spans at lower left, follow same procedure as above, using range curves at lower right. Read 1.5 percent drop.

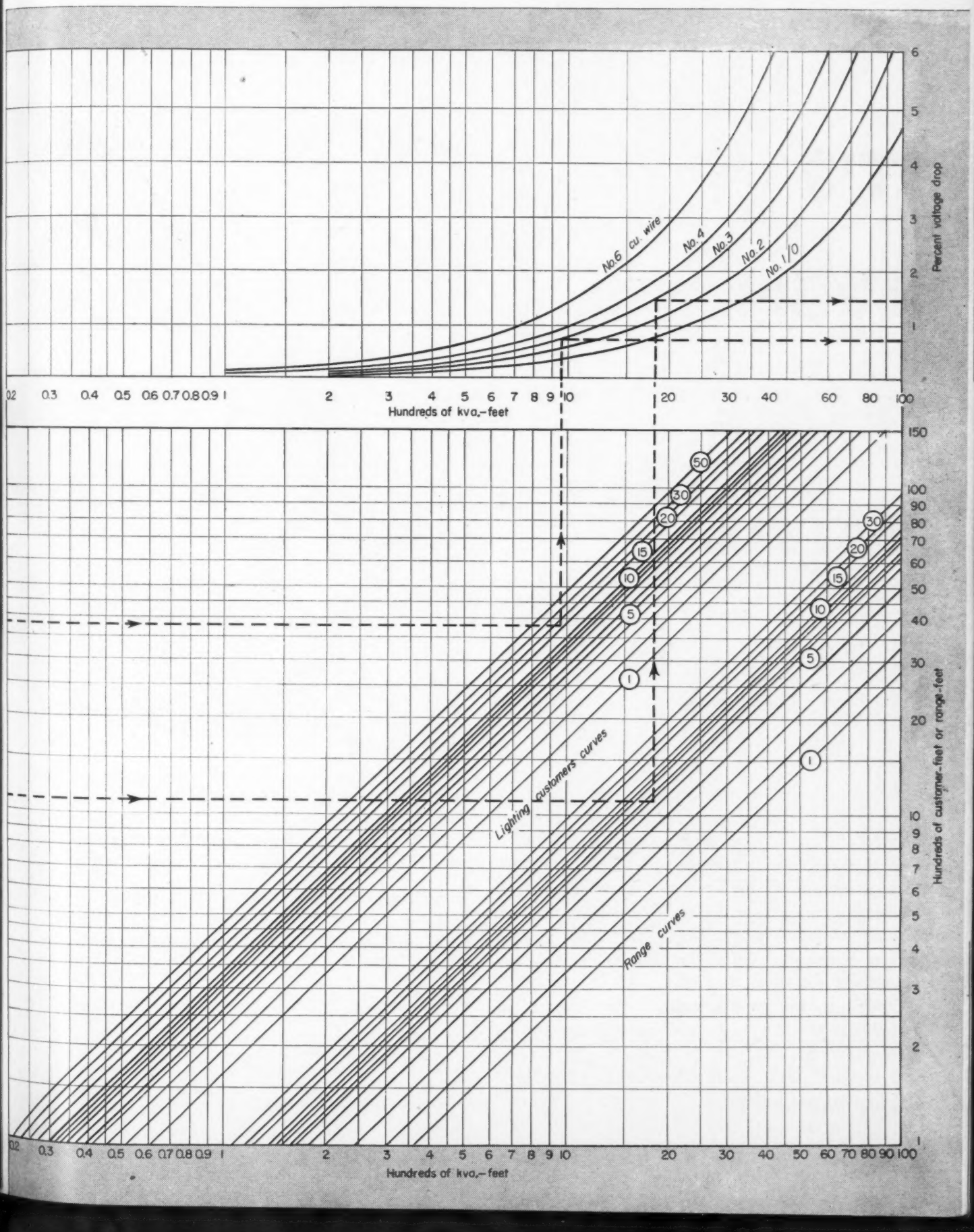
Add both values for total drop of 2.3 percent.



Secondary

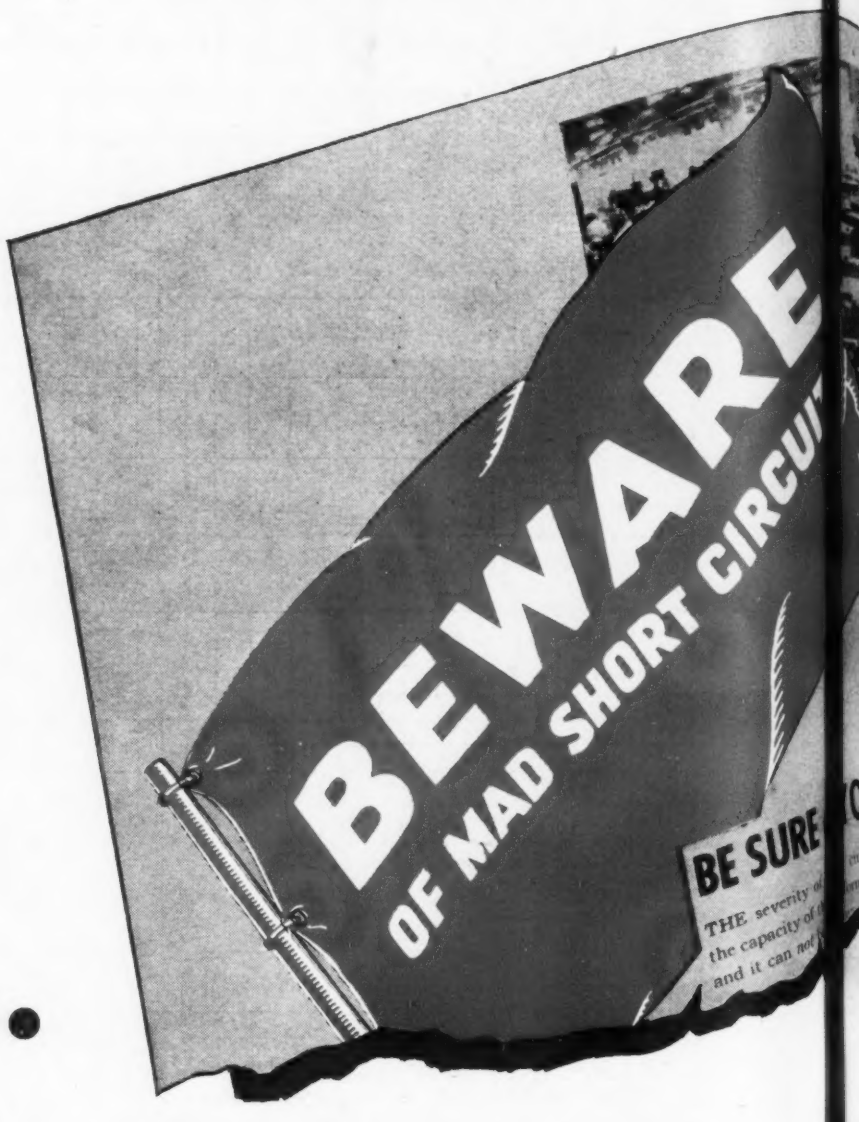
F. W. NIMMER

General Distribution Engineer, Ohio Edison Co., Akron, Ohio



REMEMBER

IT'S EVEN MORE VITAL TODAY...



Hundreds of industrial plants today are again risking costly production stoppages, equipment damage, and personnel casualties because of low-voltage protective devices that lack adequate "IC"—interrupting capacity.

Conditions dangerous to personnel and equipment can be corrected and power shutdowns eliminated by acting on the essential facts first set forth in General Electric's "IC" advertising of eight years ago.* They are:

1. *Know the "IC" of your low-voltage protective devices.*

2. *Be sure the "IC" is adequate* to interrupt full short-circuit current.

Maximum short-circuit current is *not* determined by the normal load on the circuit. The total capacity of the transformers feeding the circuit is the critical factor.

It's easy to select the proper G.E. air circuit breakers. They have adequate "IC" to help safeguard your production, equipment, and personnel.

*In the much discussed 1939 "IC" advertising, General Electric repeatedly warned industry of the hazards of using low-voltage protective devices of dubious or insufficient "IC." As a result, many plants checked their "IC" and replaced inadequate devices with air breakers of known "IC." Now, even greater hazards are present as war- and peace-expanded transformer capacity in many plants has outgrown the low-voltage protective devices.

THIS ?

If you check your "IC"
Interrupting capacity
You'll Want to Install Air Circuit Breakers
at Once on Main and Branch Feeders
THEY not only have plenty of "I C"
they provide overcurrent protection, with adjustable time delay, and
you can restore service at once by
simply turning the handle.
OUR "IC"

Air breakers with adequate "IC" pay off in dollars as well as in safety. They minimize production delays. A turn of the handle and power is restored—no parts to be replaced. By providing *three-phase* interruption of dangerous overcurrents, G.E. air breakers also prevent the harmful single-phasing of motors.

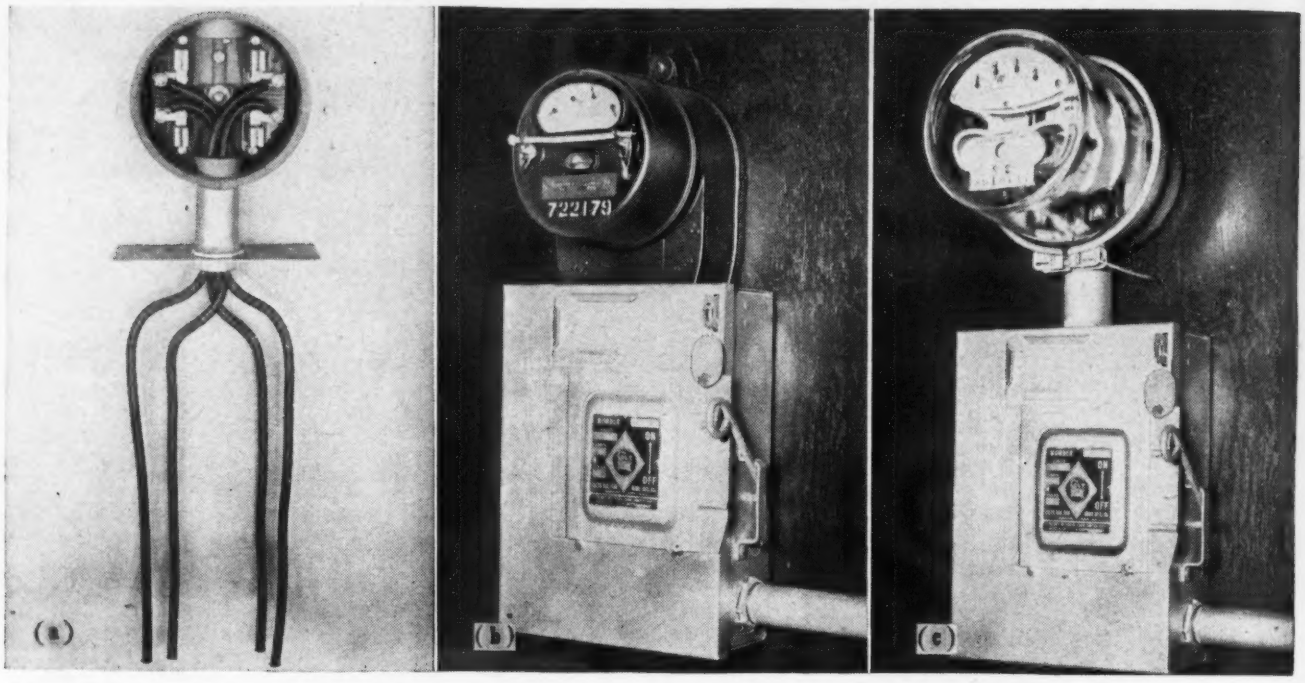
Are you *sure* of the "IC" of the protective equipment in *your* plant? If not, your G-E sales representative will gladly help you. Or write for bulletin GEA-3600 describing air breakers up to 100,000 amperes interrupting capacity. Bulletin GET-1113 explains how to select G.E. air circuit breakers. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

660-28-7500

How to Adapt Socket Meters to Cabinets

O. H. ZAMORE • Investigator, Meter Section, Boston Edison Co.



(a) MATERIAL for changing "A" type meter installation at cabinet to socket type . . . (b) Before changing "A" type meter to socket type . . . (c) Completed installation of socket meter at cabinet

A SIMPLE METHOD has been devised whereby "A" type meters installed on cabinets can be replaced with socket type meters. It eliminates the need of providing additional "A" type meters to replace those on the system and permits use of socket type as standard for most installations.

The wiring material required consists of an end plate, a nipple with locknut and bushing, a meter socket and wire. The end plates have holes for 1-in. or 1¼-in. conduit and are designed to fit over the opening provided for the "A" type meter on top of the cabinet. A 3-in. nipple (1-in. or 1¼-in. pipe size) threaded into the hub of the meter socket is fastened to the end plate with a locknut and bushing. The use of a 3-in. nipple affords ample clearance from the cabinet for a test jack.

After the "A" type meter has been removed, the above assembly is mounted on the top of the cabinet and wired for the installation of a socket meter. The line and load wires are extended to the meter socket through the short nipple. The socket meter is connected ahead of the fuses in the meter cabinet, thereby insuring registration if one fuse should blow. Socket meters installed in this manner are specially desirable on installations where persons have interfered with proper registration of 3-wire "A" type meters without separate potential connections by removing a meter cabinet fuse.

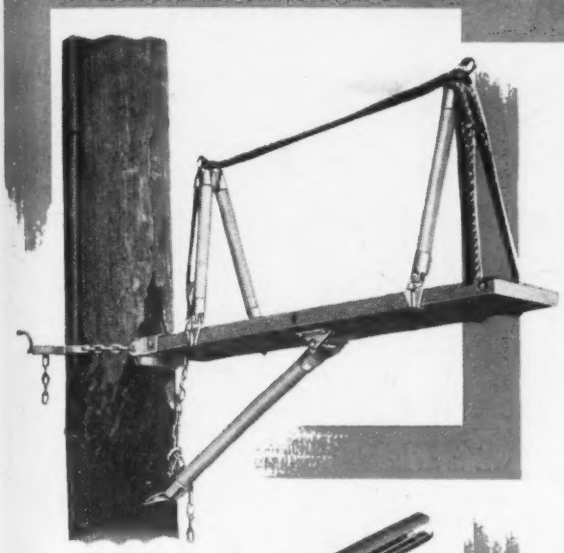
A few of the older 25- and 50-amp. meters serving domestic customers having electric ranges have been re-

Rake Trash Racks Safely

A SLIDING safety belt attached to a steel messenger cable along the walkway above trash racks at Tomohawk hydro plant of Wisconsin Public Service Corp. keeps the operator from falling in while raking trash

For GREATER SAFETY On HOT LINE Work

Use these KEARNEY PRODUCTS

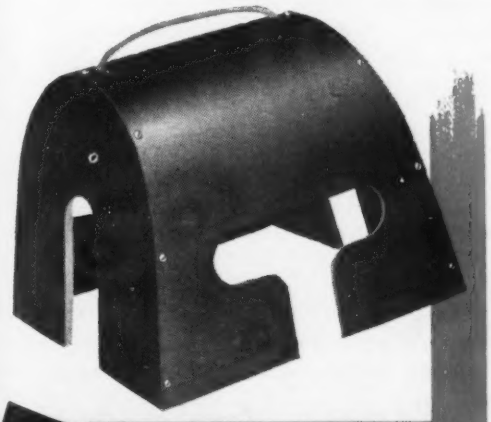


Kearney Hi-Line Platform Provides Full Wood Insulation

from grounds or short circuits. Metal fittings are held to a minimum. A comfortable safe position can be maintained by the lineman. The ridge rope provides a place for the lineman's safety strap. Solid anchoring eliminates side sway and horizontal movement of platform. It's easy to install and safe to use on wood poles, round steel poles or tower legs. Made of treated Douglas Fir tested to withstand 75 KV per foot for 5 minutes.

Kearney Hi-Line Guard

makes the lineman's work safer than ever. Simply hook the guard over the conductor, using the completely insulated handle attached to the center of the guard. The inside cylinder is then rotated to close the guard completely. The low moisture absorbing material is not harmed by sunlight or oil. Provides a means of handling high voltage lines where rubber goods are not recommended. Available in three sizes to handle voltages up to 46 KV.



Kearney Hi-Line Insulator Cover

is used with the line guard shown above. When properly installed the projection on the end of the line guard locks inside the cover. Available in two sizes to handle voltages up to 46 KV.

For greater safety, extra convenience, faster line maintenance, use these Kearney products.

84

For Better Results

Specify Kearney Products

JAMES R. KEARNEY CORPORATION

OVERHEAD AND UNDERGROUND UTILITY EQUIPMENT

4224-42 Clayton Ave., Saint Louis 10, Mo. • Canadian Plant, Leaside, Ontario

placed with 15-amp. socket meters, thus improving light-load registration. Originally it was planned to continue with similar changes and gradually reduce the number of large "A" type meters in domestic installations; but the war and current shortage of meters halted this program temporarily.

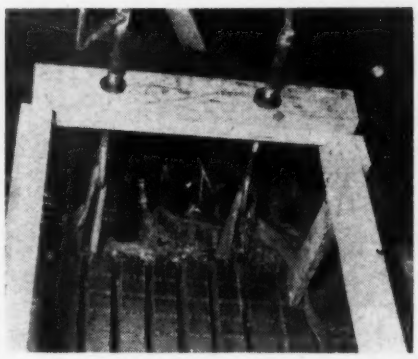
• • •

Screw Type Coil Puller Removes Stator Winding

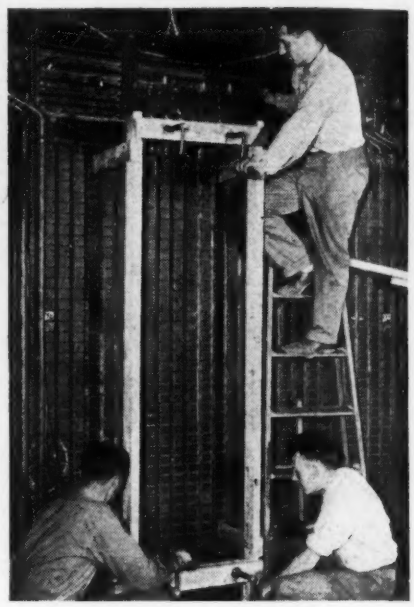
DURING the recent stator winding repair to one of the 108,000-kw. generators in the Grand Coulee Power Plant, an improved method of coil removal was improvised which increased the rate of removing coils and also caused less damage to insulation during removal. This method was developed because of the extraordinary difficulty encountered in breaking coil ends loose from the stator iron where they had been solidly cemented by insulating paints and varnishes. It was necessary that even and continuous tension be applied at all four coil corners in order not to damage the insulation.

For this particular repair job the standard method of using a web belt and pick handle for prying coils loose proved inadequate in that it was almost impossible to remove a coil without damaging the insulation beyond repair.

As a result, a simple screw puller was developed as shown in the accompanying illustrations. It consists of a wooden frame held away from the stator iron by four wooden legs and of four screw pullers installed so that one puller exerts a radial force at each corner of the coil. With this arrangement of applying force to each coil corner as desired, the coil is removed as evenly as possible and insulation failures are reduced to a minimum. Puller forces are kept low by continuous striking of the coil with a rubber mallet as the force is applied.



DETAILED VIEW of screw puller and web belt being applied to top end of stator coil. Striking the coil with a rubber mallet during pulling helps to free coil



COIL PULLER is an improvement over web belt and pick handle method of prying loose stator coils. Even and continuous tension is applied at all four coil corners, minimizes damage to insulation

This coil puller proved a very convenient and inexpensive method of removing stator coils where the ordinary procedure was found to be inadequate.

• • •

A Guide for Manhole Inspections . . . I*

A PROCEDURE for inspection of manholes and for testing for gas as outlined here is an adaptation from instructions issued by the Distribution Division of an Eastern electric utility.

All manholes carrying 13.2-kv. cables or which have sewer connections are inspected at least yearly; others at least every five years. This includes any privately owned manholes carrying company cables. Particular attention is given to condition of cable joints, lead sheaths, hangers, and proper tagging. General condition including gas presence is reported. Live 13.2-kv. cables must not be disturbed by inspection procedure. Mirror is used for indirectly visible parts. At inspection, manholes are thoroughly cleaned, disposing of any debris and returning scrap metal to stock.

Proper racking and minor repairs to cables, hangers, etc., are checked and handled at inspection; other repairs are reported for later attention.

In sewer-connected manholes, traps are inspected, cleaned and flushed with two or more pails of clean water, followed by pouring in enough oil to film over water left in trap. This is to prevent evaporation. Used crank case oil from motor vehicles is employed. Trap condition (wet or dry) and flushing and oiling are reported with other items on prepared forms.

Inspection Lists

Report forms for manhole inspection will be presented in a subsequent issue.

By each March 15 the records are examined and a list made of all manholes not reported during the inspection period. By October 1 a list is prepared of all sewer-connected manholes. The general line foreman causes these to be inspected and results reported to the joint line representative. Inspection and reports from the March 15 list must be com-

* A series of two articles. Illustrations have sequence numbering in the series.

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pleted by the next May 1, and by November 1 after the October list and inspection. Report records are then transferred to cards.

At the March inspection all potheads on company-owned cables in sites where the apparatus is not maintained by the utility are visually inspected by a cable splicer. Cracked or broken porcelain insulators, leaking compound, improper condition of insulation, necessary painting or stencilling, etc. are reported. At this time a cable splicer travels over the route of every buried or submarine cable, reporting any places where such cables are exposed to damage.

The joint line representative furnishes the general line foreman with a list of potheads and cables to be inspected, receiving the list back after work is done and keeping it as a record.

Apparatus—Wet Manholes

The joint line representative marks with a red "Smith Signal" (metal clip of spring steel 1 in. x ¼ in.) every card for a manhole containing apparatus such as transformers, oil cutouts, etc., which depend on gaskets or any device except wiped or soldered joints for dryness. The card must carry a description of such apparatus.

All manholes found wet must be so marked in red ink on their cards and also with a yellow signal. All such apparatus manholes are checked for water conditions at the time frost is leaving the ground, and reported on the manhole inspection form.

FIG. 1—Using manhole gas condition indicator. Cover has been opened just enough to admit "antenna" or tube to sample atmosphere within manhole

An up-to-date list of wet manholes is kept, and these manholes are checked as often as necessary and pumped out, with report made on the form on the reverse side covering all checks and other operations in relation to water conditions.

Gas Inspection

Every company manhole known to have illuminating gas present is annually tested for this during April and May. At the same time at least one manhole in every direction from the gas-filled area is tested.

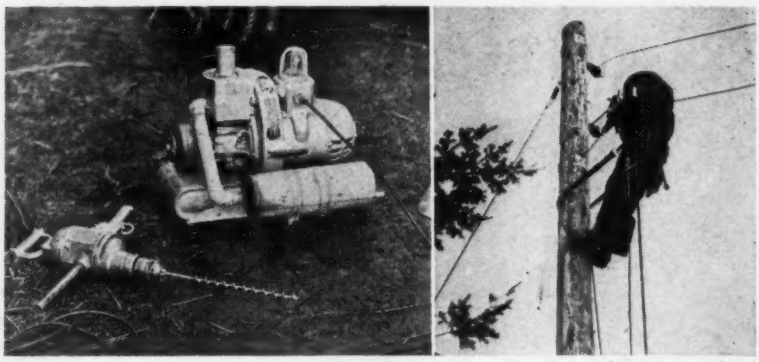
An up-to-date list of all such manholes is maintained. Manholes are removed from the gas list when any two successive tests show no gas present.

Test is made by raising the manhole cover as little as possible, inserting the antenna of a "J.M." indicator* (Fig. 1) and taking readings. Results are recorded and the test is done by one electric utility man accompanied by a gas company man when possible, the gas man being allowed to enter the hole after the test.

Tests made by the maintenance engineer which indicate a dangerous (yellow) or explosive (red) condition, when a gas man is not present, must be reported to the gas company by the former. Areas in the vicinity of the gas plant where gas continually exists are reported to the gas company only if the test indicates an explosive condition.

* The "J.M." indicator (Fig. 1), manufactured by Johnson William, Ltd., Palo Alto, Calif., and distributed by Davis Emergency Equipment Co., Inc., 67 Wall St., New York, N. Y., consists essentially of a Wheatstone bridge. One arm is a metal whose resistance varies with the amount of gas present in the surrounding atmosphere. A rubber bulb draws gas from the manhole through a tube into the chamber surrounding this metal. The resistance is measured and indicated on a Millimeter scale calibrated in degrees of explosiveness.

Packaged Power for Line Work



PORTABLE engine-driven a.c. generator (left) supplies on-the-job power for portable labor saving tools (right). Same unit feeds floodlights for emergency night work and can be used for other jobs

PORTABLE engine-driven generators are being used advantageously by Portland (Ore.) General Electric Co., to supply power for portable drills in building transformer and other special structures and to furnish power for floodlights for emergency night work. The outfit shown is a Homelite packaged power unit that delivers 2.5 kw., 115 volts, a.c. Weight is about 130 lb.

Poles for line extensions are ordinarily gained and bored before being set, so it is in building transformer and other structures that the portable unit finds its greatest use for boring holes. For emergency night work the floodlights are an obvious great advantage. Portland General Electric plans to supplement the three large units it now has with some smaller units that will be even more portable for on-the-job power.

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UTILUX SUBURBAN LUMINAIRES

1 Controlled reflection puts the available light on the pavement where it is needed.

2 This distribution of light plus high reflector efficiency results in more useful light per watt.

3 Irritating glare due to high angle light is eliminated.

The New Joslyn Utilux Suburban Luminaire meets the present demand for better and more efficient suburban street lighting at five important points:

4 Rugged Durable Structure.

MORE USEFUL LIGHT PER WATT

5 Economical both from the standpoint of initial cost and long life.

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LOAD BUILDING

Cost to Serve House Heating

Intensive effort being made to determine distribution costs in serving electric house heating load. Long-view analysis provides preliminary limited data

HARRY G. KELSEY*
Longview, Wash.

WHAT is the cost of supplying service to space heating load? This is the important question in every distributor's mind. Agencies of the Pacific Northwest, both public and private, are actively engaged in studies, first, how to go about determining costs, and secondly, what these costs are. The answer probably will be different for each distributor depending upon many factors. Any cost analysis of necessity must be based upon allocations and assumptions which in themselves are subject to discussion and argument.

Having developed certain data concerning characteristics of space heating load,* the Cowlitz County P.U.D. undertook to arrive at some cost information. The following comments and data apply to conditions existing in Longview, although some may be applicable to other localities.

Due to many influencing factors, Longview is in effect buying energy from the Bonneville Power Administration for electric house heating on a rate which at present does not exceed 2½ mills per kw.-hr. The average annual resale rate for this service is about 6½ mills, leaving a 4-mill margin to cover other elements of cost. Analyzing the additional investment in one primary and secondary line occasioned by serving seven electrically heated homes, it was found that this added investment was $158, comprising the added cost of heavier secondary and service wires and transformer capacity. The additional annual revenue from these seven heating installations totaled $384.67, or a ratio of $2.43 of annual revenue per dollar of additional investment, which compares quite favorably with accepted practice of extending rural lines on a ratio of $0.20 annual rev-

Analysis of Cost to Serve Space Heating Load

ACTUAL DATA			
Avg. annual heating revenue per customer (38 customers)	$68.58		
Avg. annual heating kw.-hr. per customer (38 customers)	10,463		
Avg. rate per kw.-hr.	6.62 mills		
Avg. connected heating load per customer (38 customers)	15.5 kw.		
ASSUMED OR CALCULATED DATA			
Calculated annual heating kw.-hr. per customer at substation including losses of 10%	11,625		
Developed incremental heating demand per customer at transformer	5.0 kw.	7.5 kw.	15.5 kw.
INVESTMENT DATA			
Distribution substation capacity @ $15.68 per kva	$ 78.40	$117.60	$243.04
Distribution copper and transformer capacity @ 15.00 per kva	75.00	112.50	232.50
Additional service and meter capacity per customer	25.00	25.00	25.00
Sub Totals	178.40	255.10	500.54
Sub-transmission line copper 13 kv. @ $2.50 per kva	12.50	18.75	38.75
Totals	$190.90	$273.85	$539.29
DEDUCTIONS FROM REVENUE			
Fixed Charges:			
Interest 2½%, amortization (or depreciation) 4%, Total 6½%	$12.41	$17.80	$35.05
Taxes:			
3% state business, 2% state privilege, Total 5% of revenue	3.43	3.43	3.43
Distribution Expense:			
Operation and maintenance: ½ of present costs per customer	2.87	2.87	2.87
Purchased Power.			
11,625 kw.-hr. @ 2½ mills	29.06	29.06	29.06
Totals	47.77	53.16	70.41
BALANCE—Revenue Less Deductions	$20.81	$15.43	$ 1.82

* Formerly with Cowlitz County Public Utility District No. 1, and manager at time article was prepared.

* ELECTRICAL WORLD, November 24, 1945, p. 82.

To Remind Employees

Customer Facts

A CUSTOMER—is the most important person to enter your place of business.

A CUSTOMER—is not an interruption to your work. He is the purpose of it. You are not doing him a favor by serving him—he is doing you a favor by giving you the opportunity to do so...

A CUSTOMER—is not an outsider to your business—he is a vital part of it...

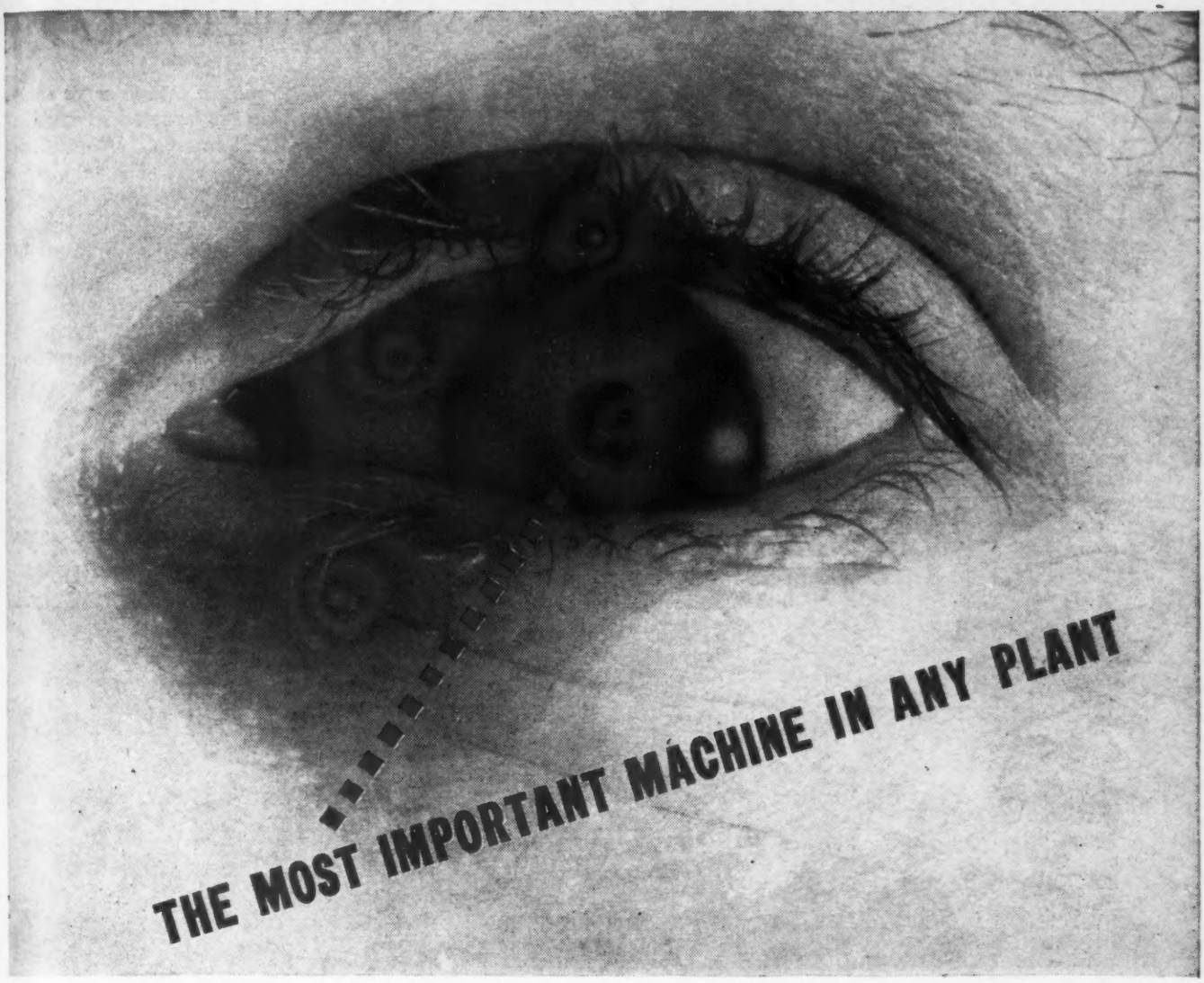
A CUSTOMER—is not cold statistics—he is a human being with hopes and emotions like your own...

A CUSTOMER—is a person who brings you his wants. It is your job and duty to handle them with promptness, courtesy and consideration.

A CUSTOMER—is not dependent on you... you are dependent on him. He pays your salary...

GEORGIA POWER COMPANY
A Citizen Wherever We Serve

ON EVERY bulletin board in Georgia Power Co. offices is posted this sign for guidance of employees—and customers can also see how highly they are esteemed



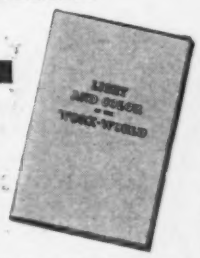
No matter what the process or the product being manufactured, there's one "machine" in every plant that's more important than any other...

THE HUMAN SEEING MACHINE!

No one knows this better than the Illuminating Engineer and the lighting fixture manufacturer. And no one knows better, either, how important *good lighting* is to quick, easy, accurate seeing.

But don't forget that even the finest lighting system can't do an efficient, economical job unless it is backed up by ceilings and walls which reflect a maximum of the light emitted and help distribute it evenly throughout the working area. That means WHITE paint—for white reflects far more light (80-90%) than any other color under both incandescent and fluorescent illumination.

For nearly half a century BARRELED SUNLIGHT has consistently supported the lighting industry in its job of providing better light for better sight. For further data on how white paint can help make good lighting even better, send for a free copy of our 32-page booklet, "Light and Color in the Work-World." Just fill out and mail the coupon TODAY.



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MY TITLE .....

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All available indications point to the fact that lead for cable coverings will be short for the next year at least. But this lead shortage shouldn't unduly upset you for ANHYDREX Cables with a hard service rubber jacket will give you the dependable service you want without many of the difficulties that are inherent in the use of a lead sheath.

Simplex-ANHYDREX Underground Cables can be installed directly in the ground or they can be used in ducts. They are not subject to electrolysis or corrosion. Acid or alkaline soils have no effect on them. Sheath currents resulting in galvanic action cannot occur with a rubber jacket.

Simplex-ANHYDREX Underground Cables were the first to be offered with a low water absorption insulation and a hard service rubber jacket for use underground, without ducts.

Beat the lead shortage by buying and installing Simplex-ANHYDREX Underground Cables. A new ANHYDREX Underground Cable book is ready. We'll gladly send you a copy on request.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

enue per dollar of added investment (5 to 1 investment ratio).

In determining cost to serve space heating load the largest variable factor influencing cost is kilowatt demand per customer. The tabulation herewith sets forth generally the major elements of cost on assumed customer demands of from 32 to 100 percent of the connected heating load. It is believed that experience will indicate demands in that range depending upon percentage of saturation. Costs are typical of those prevailing on the Longview system.

•

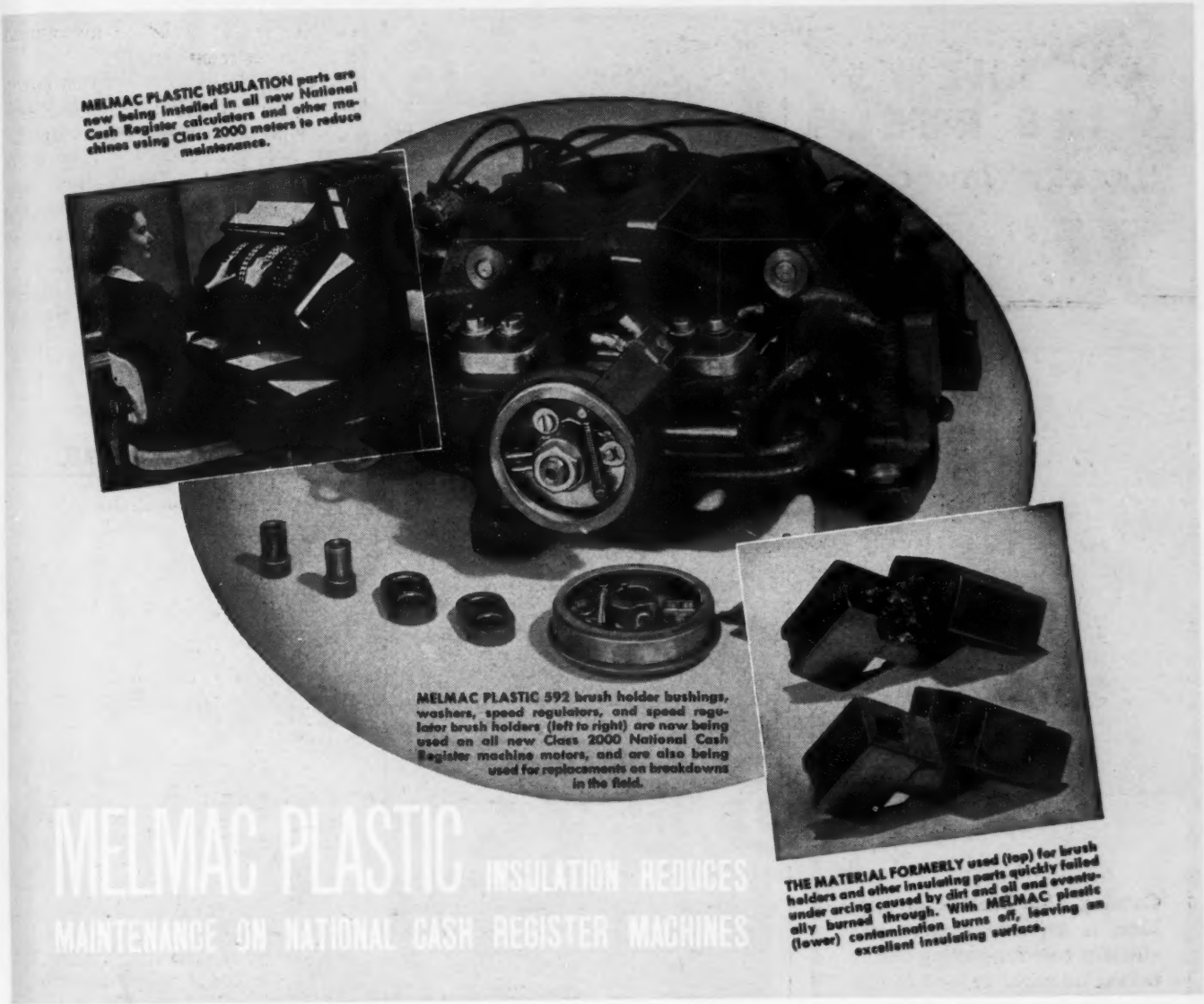
Personalizing the Company Pays Off in Results

TO BRING YOU SUMMER COMFORTS FOR A FEW CENTS A DAY
Every hour—day and night—members of the Louisiana Power & Light family are on the job. They help bring you Cheap Electricity—for a cool, pleasant summer.
Electricity from
LOUISIANA POWER & LIGHT COMPANY
is Cheap!

TYPICAL ADVERTISEMENT introducing power company people

NOT ONLY are consumers in its trade territory sold on the company as a friendly good neighbor—but employees in various departments do their work with more zest and like it better, as the result of a public relations advertising campaign run by Louisiana Power and Light Co. The campaign dramatized utility employees and their jobs as a means toward teaching consumers the vital and friendly part the company plays in their everyday lives.

Since most of the 80,000 customers of Louisiana Power and Light live on farms or in smaller communities, it was decided, when the campaign was proposed, to play up the activities of


MELMAC PLASTIC INSULATION parts are now being installed in all new National Cash Register calculators and other machines using Class 2000 motors to reduce maintenance.
MELMAC PLASTIC 592 brush holder bushings, washers, speed regulators, and speed regulator brush holders (left to right) are now being used on all new Class 2000 National Cash Register machine motors, and are also being used for replacements on breakdowns in the field.
THE MATERIAL FORMERLY used (top) for brush holders and other insulating parts quickly failed under arcing caused by dirt and oil and eventually burned through. With MELMAC plastic (lower) contamination burns off, leaving an excellent insulating surface.
MELMAC PLASTIC INSULATION REDUCES MAINTENANCE ON NATIONAL CASH REGISTER MACHINES

Costly repairs and involved service charges for replacements are being eliminated by the installation of MELMAC* plastic 592 insulation parts in the motors of National Cash Register machines. Rigorous tests show that MELMAC parts operate more dependably than those made of the general-purpose plastic formerly used because of MELMAC's high arc resistance and excellent insulating properties.

Comparative tests of the two materials in rotating parts such as speed regulators and speed regulator brush holders were made under actual working conditions on Class 2000 motors.

During track resistance tests, a mixture of oil and carbon dust was smeared on the insulating parts. When the carbon brushes in the brush holders contacted speed regulators, this contamination caused arcing. The material formerly used showed an immediate track and eventually burned through. With MELMAC, contamination burned off, leaving an excellent insulating surface. Brush holders of the former material burned out and had to be replaced at 24, 35, 106, 250, 335, and 1173 hour intervals. Speed regulator insulators had to be replaced at 250 and 772 hours. All MELMAC parts were still functioning as insulators at the termination of 1423 hours.

If such exceptional arc resistance and dielectric strength in an insulating material are important to you, let us give you complete details on our mineral-filled MELMAC plastic 592. *Reg. U. S. Pat. Off.*

TYPICAL PROPERTIES OF MELMAC PLASTIC 592	
Dielectric strength	430 volts/mil.
Arc resistance (ASTM)	Avge. 130 sec.
Heat resistance	300° F.

AMERICAN CYANAMID COMPANY
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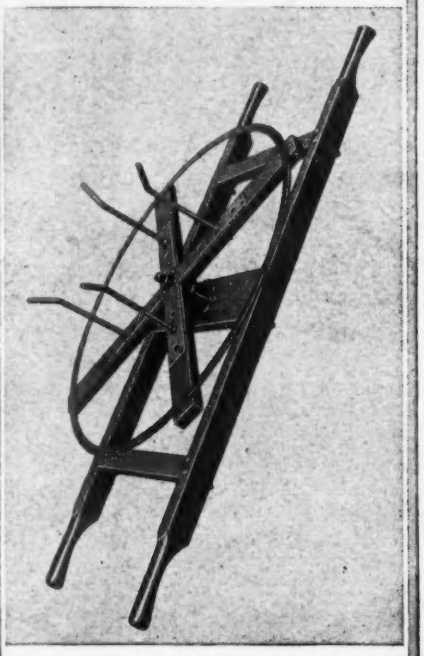
MATTHEWS WIRE REEL

a reel at low cost



Catalog 17-A Matthews Wire Reel is an inexpensive yet efficient tool for paying out or taking up wire. It is of sturdy construction and can be used for heavy as well as light work. The frame and cross members of turn table are of durable white oak and base, flange and coil arms are of cast malleable iron. Turn table revolves very easily with full coil of wire. Coil arms can be adjusted for coils of wire having inside diameters of 12, 18 and 24 inches. Complete reel finished in olive drab enamel. Base casting and turn table only, can be furnished for truck mounting or store room installation. Frame 70″ long x 24″ wide, overall height 19″, diameter of turn table 42″.

Write for descriptive information and price

W. N. MATTHEWS CORPORATION

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company employees rather than of the company as a whole in order to sell these consumers on the fact that the utility was not a large and soulless corporation furnishing electrical service in return for enormous profits, but just an everyday, country-style good neighbor.

This primary result was achieved and, in addition, a secondary "return," fully as important as the first, but unlooked-for in the company's original plans, was brought about. Employees' morale perked up. Workers took more interest in their jobs, liked their positions better, liked the company itself better as they began to understand, in a way they had never before understood, the vital connection between work they performed and services to the community, and as the part each played in total operations of a big utility company was borne home to him by the ad-dramatizations of the job classifications.

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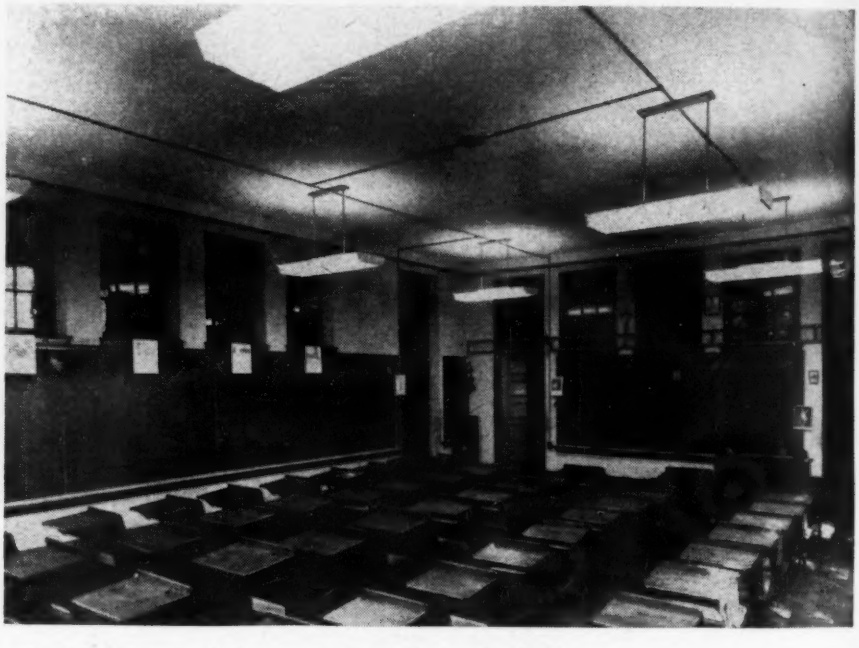
First Things First in School Lighting

F. W. OGDEN • Savannah Electric & Power Co., Savannah, Ga.



RELIGHTING comes before repainting in Savannah school

RELIGHTING and repainting the rooms of the Sacred Heart parochial school in Savannah, Ga., had long been planned by the school head, Father Robert Brennan. Without any local precedent to go by, Father Brennan and his associates, acting on the advice of their electrical contractor, the Dotson Electric Co., called into consultation the lighting department of the Savannah Electric & Power Co.

After consideration of several plans, it was decided to install 6 four-lamp fluorescent fixtures in each of the ten 740-sq. ft. classrooms. The fixture chosen was the Westinghouse LW-160 unit with egg-crate louvers. Unfortunately the money available for the improvement was somewhat limited and the expense of buying and installing 60 fixtures would make a big dent in it. The question arose, "Should a complete job of relighting and repainting be done in some of the rooms, leaving the others for later attention, or should all the rooms be relighted at once and the painting done later?" It was agreed that the complete lighting job should be done first.

This is the explanation for the dull looking walls and ceiling in the accompanying picture of one of the relighted classrooms. Since the rooms are not used at night, advantage of daylight could be taken by placing the fixtures nearer to the inside walls. The calculated in-service intensity averages 23 foot-candles.

The FIRST LINE OF PROTECTION AGAINST CORROSION

—Federal's Cathodic Protection Selenium Rectifiers

Mr. M. C. Miller (*left*) *Corrosion Engineer* of EBASCO Services, Inc., N. Y., and Mr. W. F. Bonner (*right*) *Equipment Engineer of Federal's Rectifier Division*, inspect cathodic protection rectifiers on the production line, prior to shipment.

SEE FEDERAL'S SELENIUM RECTIFIER DISPLAY, at the Exhibition of NACE—Palmer House, Chicago, April 7, 8, 9, 10.

Ordered in quantity by a large Southern Utility for protection of underground cables

These cathodic protection rectifiers will soon be standing guard over the vast network of underground power cables of a large Southern utility company — assuring maximum service continuity by preventing the ravages of electrolytic corrosion.

Your underground-corrosion problems can also be solved with these economical, dependable, Federal rectifier equipments — for protecting oil pipe lines, gas mains, water tanks, petroleum storage tanks, power and telephone cables.

Federal now has a production program under way whereby these *Standard* Cathodic Protection Rectifiers will be readily available to you. Select the Rectifier most suitable to your needs from our new catalog listing *Standard Equipments*.

Rectifiers which convert alternating to direct current for cathodic protection must be simple, rugged, long-lived — operating without attention or maintenance for long periods of time, in a wide range of ambient temperatures, in all kinds of weather. Federal's cathodic protection rectifiers are especially designed for just this kind of service — and they've been *proved* in hundreds of installations, many under the most severe temperature and climatic conditions.

Federal Selenium Rectifiers protect lead-sheathed cables by supplying a steady flow of dc from soil to sheath, offsetting the corrosive effects of galvanic sheath-to-soil currents.
STEEL RAIL GROUND BED
LEAD SHEATHED POWER CABLES
CATHODIC
Federal
STANDARD SELENIUM RECTIFIER EQUIPMENTS

SEND FOR THESE BOOKLETS TODAY. They give valuable performance data and application information on selenium rectifiers for cathodic protection. Write to Federal, Dept. E817.

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100 Kingsland Road
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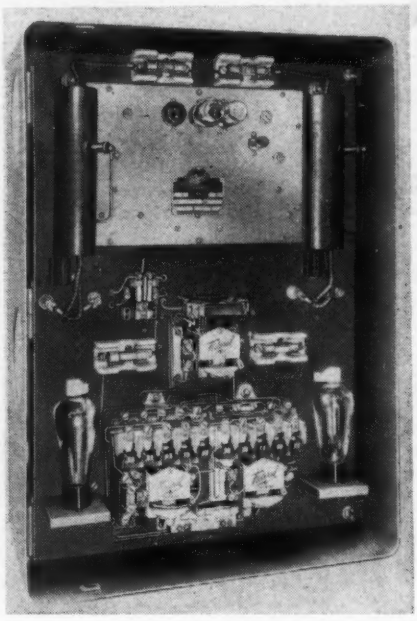
NEW EQUIPMENT

Electronic Unit Provides Motor Speed, Current Control

TWO MODELS of a new electronic motor control for operating d.c. motors from a.c. power has been announced by Federal Electric Products Co., Newark, N. J. One model is a general purpose, reversing type applied to a 2-hp., 230-volt d.c. motor, and the second is a special control for an abrasive M-3 surface grinder, it was made known by the developers of the units.

The manufacturer reports that the control provides an almost flat speed torque curve with changes in load having little effect on speed. Electronic circuits incorporated in the unit also limit the current to the preset value regardless of the load. The manufacturer states that this value of current is not exceeded when the armature is locked mechanically and the speed setting is placed at maximum.

In addition to limiting the current, the unit is reported to provide stepless acceleration. These features are stated to protect both motor and control in case of overload, and to protect the load since current limiting action is also torque limiting action.



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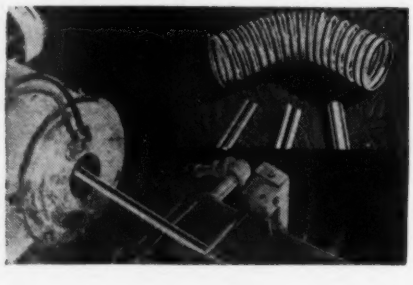
Mutiple-Color Plastic Extrusion Process Developed

THE DEVELOPMENT of a new process for the production of controlled multiple-color extrusion of thermoplastics in a single operation has recently been announced by Schwab & Frank, Inc., 2941 East Warren Ave., Detroit 7, Mich. This product will be known as Spectro-Line extrusion.

The new process is said to achieve multiplicity of color with precise control over color spacing, placement and volume before the thermoplastic materials leave the extrusion machine. Further, the same raw materials having identical flow characteristics are used in the new extrusion process. This is said to produce solid extruded plastic forms in which there is complete fusion between the different colored sections. This multiple-color extrusion has been tested and found to be entirely suitable for all thermoplastic material, the manufacturer reports.

As applied to the electrical field, Spectro-Line can be used as an extrusion over wire sections. It can also be used in connection with helically coiled plastic wire sections.



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New Fans Place Westinghouse In Popular Price Market

ENTERING the popular priced fan market for the first time, the Westinghouse Electric Corp. announces that its 1947 line of fans will include a 10-in. oscillating desk-bracket model—the Livelyaire. Features include a 2,000-rpm. induction-type motor.

Finished in baked-on, dark green enamel, the new fan is adjustable for wall mounting, and has a reinforced, one-piece, welded steel guard. Arc of oscillation is adjustable to any angle from 0 to 75 deg. Oscillating gears are enclosed within streamlined motor housing. Over-all dimensions: 14 in. high, 11½ in. wide, 8¼ in. deep. Base 5⅜ in. wide, 7⅜ in. deep.

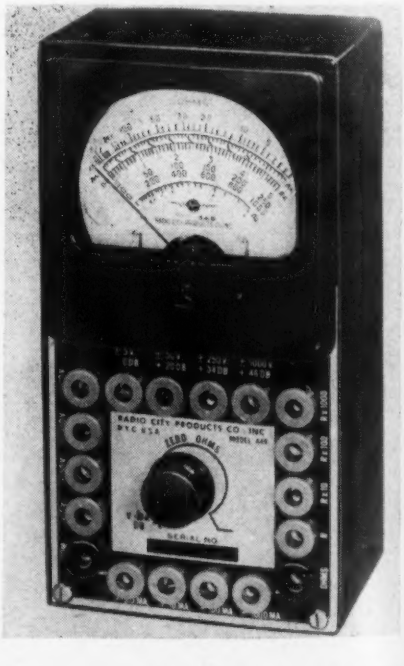
•

5,000 Ohm/Volt Sensitivity Provided in Small Multitester

A SMALL MULTITESTER which is reported to afford sensitivity usually found only in larger instruments has been announced by Radio City Products Co., 127 West 26th St., New York 1, N. Y. Known as Model 449A, it is stated to have a d.c. sensitivity of 5,000 ohms per volt, and to be effective in measuring low-current circuits where loading must be held at a minimum.

It is also reported as usable for general circuit testing. The Germanium crystal rectifier permits a.c. measurements from 30 cps. to 50 kc. The manufacturer reports that all a.c. voltmeter temperature errors are eliminated. The 3-in. square meter is reported accurate to 2 percent. Matched metallized voltage multipliers have a tolerance of 1 percent.

It is housed in a black crackle finish



HUBBARD AUTOGAP FUSE CUTOUT

NO. 2315

HUBBARD AUTOGAP FUSE CUTOUT is a combination of No. 2302, 9 KV Autogap Lightning Arrester with a new, improved 7-1/2 KV open type fuse cutout. The assembly is Stock No. 2315.

VOLTAGE, phase to ground is recommended to be limited to 7500 Volts.

FUSE rating is 50 Amperes. Fuse links are not furnished. Any standard can be used.

INTERRUPTING CAPACITY of the Hubbard Autogap Fuse Cutout is 1200 Amperes.

MOUNTING Brackets are available. No. 2323 for Crossarm and No. 2325 for pole. Specify type of mounting when ordering.

WEIGHT of the assembly is 18 Pounds each, packed for shipment.

CLOSED POSITION: The flat, phosphor bronze spring at the top is in tension, ready to kick out the mechanism instantly when the blowing of the fuse releases the tension.

OPERATING: This view shows the action during transition from "closed" to "open" positions. The fuse has blown and the toggle mechanism is forced open by the top contact spring. The gap caused by the blown fuse is instantly lengthened to at least 3-inches by the leverage of the toggle mechanism, causing the arc to be extinguished within the fibre fuse tube rather than at the top contacts, where burning might occur.

OPEN POSITION: Top contact spring is relaxed, having exerted its pressure toward opening the mechanism. Tube drops to hanging, open position which places the notch for "hot-stick" removal of fuse tube in an accessible spot

HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

metal case, which affords complete shielding. The self-contained batteries are spring-clip mounted to facilitate changing.

•

"Pillbox" Type Coin Radio Resists Vandalism

INTRODUCTION of a new Telecoin System coin radio for hotels, motor courts and hospitals has been announced by the Telecoin Corp., 12 East 44th St., New York, N. Y. Distribution of the new set will begin on or about April 1, according to Howard E. Richardson of that company.

Varying in design from conventional radio styles, the Telecoin System has been engineered to resist vandalism and abuse which were a major problem in earlier designs. "Primary concern was for an extremely strong case and chassis to prevent vandalism," he stated. "Equally vital was adequate protection from coin box pilfering and 'free play' tinkering. Ready accessibility of the set for service and maintenance was another consideration."

A pillbox shaped affair, the radio has a 16-gage steel case and chassis. Hammer tone blue in color, the 20-lb. set features a baked enamel finish which will resist 180 proof alcohol and cigaret burns, it is reported. Another innovation to forestall accidental damage is the inch-and-a-half setback of the controls and scarlet-lined dial face within the case.

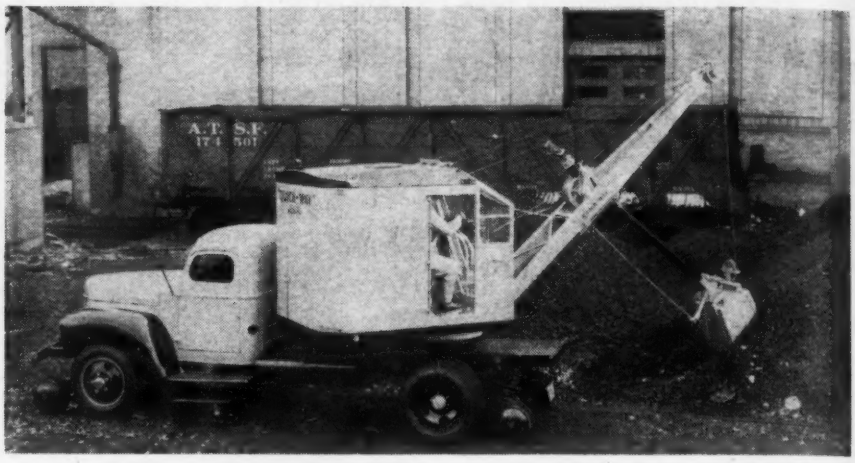
Protection and facility for service are combined in a case which is removable for service operations, but secured with a screw-type lock. A separate screw-type lock secures the interior coin box. The time element is variable, permitting 30-min., 1-hr. or 2-hr. play. The radio has over-all dimensions of 9 in. by 10 in. by 7½ in. and operates on alternating current, 110 volts, 60 cycles. It features a 110-volt pilot light. Design permits bracketing of the five-tube set to a wall or separate table use.

•

3,000-Watt Mercury Lamp Life Increased 1,000 Hours

A LIFE RATING increase of 1,000 hours for the 3,000-watt A-H9 mercury lamp has been announced by the lamp department, General Electric Co., Nela Park, Cleveland, Ohio. The new life rating is 3,000 hours; previously it was 2,000 hours. Electrical characteristics, initial ratings, and lumen maintenance remain unchanged, it is reported. The new life ratings apply to the lamps currently in stock.

Coal Handling Equipment Travels Road or Rail



THE Auto-Railer, with Quick Way ¼-cu. yd. truck shovel mounted on an International 147-in. wheelbase Model KB-5 chassis, is a dual purpose vehicle designed for operation on railroad tracks and highways that has been developed by Evans Products Co., Detroit 27, Mich.

The full revolving truck shovel is powered by an International Harvester four-cylinder engine. Attachments fasten to universal boom foot connection for quick conversion from shovel to trench hoe, crane, dragline, clamshell, orange peel and pile driver. The vehicle is built to go quickly and do a job where heavier equipment is not practicable or profitable, it is reported.

The Auto-Railer can be run over the highway to the railroad crossing nearest the point of work and then run on the track. All driving and braking is through special pneumatic tires which are stated to enable operation under all track and weather conditions.

Flanged steel pilot wheels, mounted on large tapered roller bearings, are designed to hold and guide the vehicle on the rails. The flanged steel wheels carry all the weight not carried by the pneumatic tires. The pilot wheels and axles are raised and lowered hydraulically by controls on the dash.

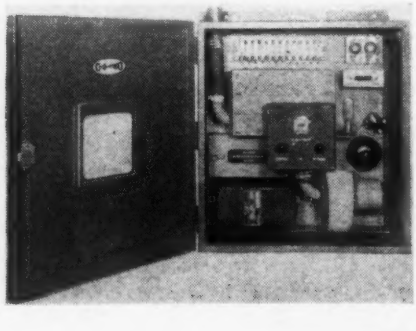
The unit can be maneuvered on the track in less than one minute. In driving off the track at a road crossing, it is not necessary to come to a complete stop, because the pilot wheels and axles are raised as soon as the road crossing is approached, at which time the vehicle is driven directly on the highway.

• • •

Industrial Smoke Detector Is Underwriters' Approved

A NEW SMOKE DETECTOR designed for use in storage or record vaults and other spaces in industrial plants has been announced by C-O-Two Fire Equipment Co., Newark 1, N. J. The smoke detector, with an enclosed light beam, operates on the principle of light reflected by smoke particles on to a photoelectric cell. It is reported as approved by Underwriters' Laboratories.

Air samples are continuously drawn into a detecting chamber where, when smoke first appears, a red lamp is lighted and an alarm is sounded. The supervisory lamp and audible alarm provide continuous supervision of the detector.



•

Photoelectric Control Protects Oil Burners

A NEW "Fireye" photoelectric flame failure safeguard for use in industrial oil burner installations has been announced by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass. It turns off the burner and the fuel supply if the flame fails.

The equipment consists of a photoelectric scanner for monitoring the main oil burner flame, and a control for programming the oil pump, oil valve and

Longer Service

ALL DOWN THE LINE

LIFE-SPAN

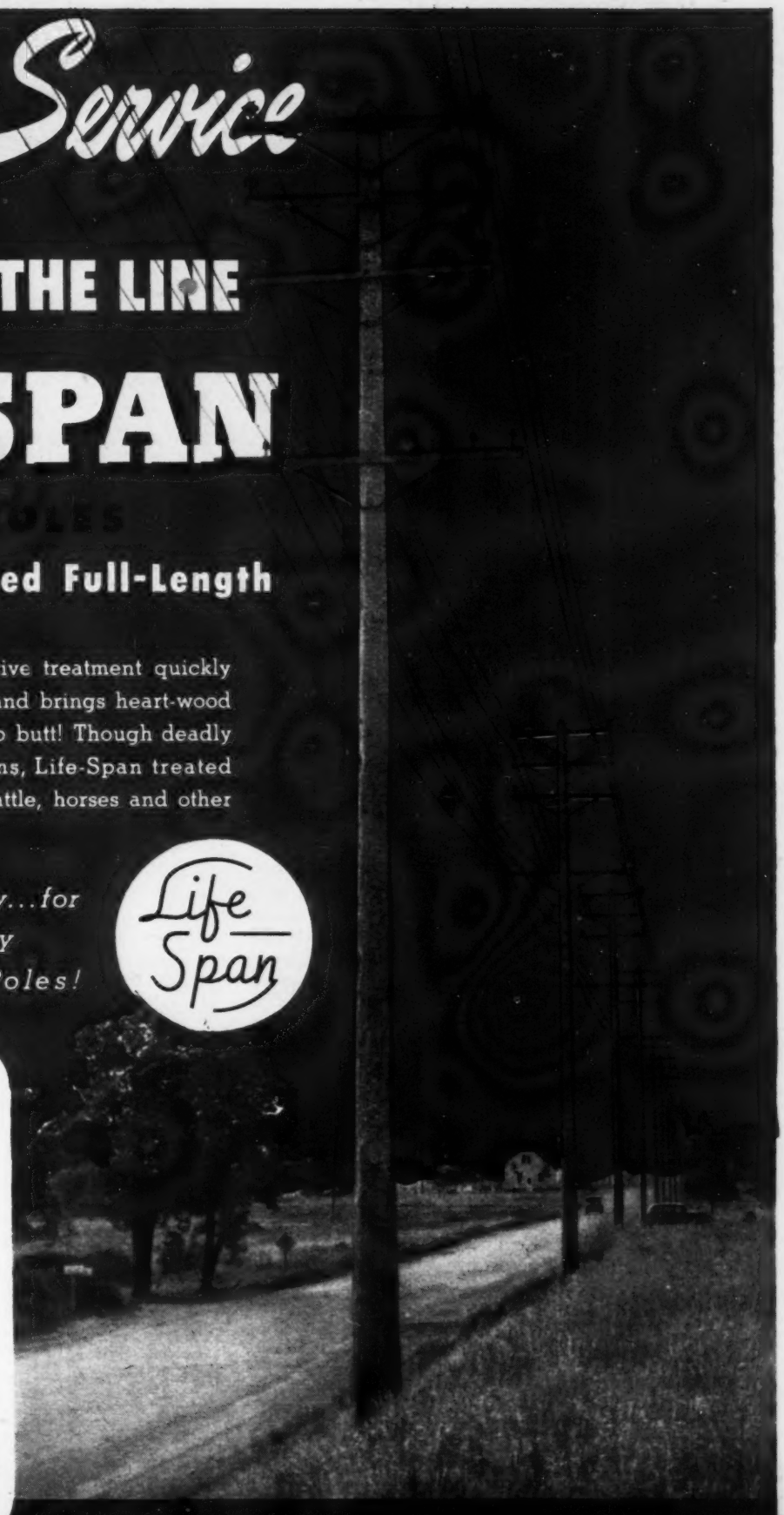
CEDAR POLES

Are Decay-Immunized Full-Length

• Life-Span's full-length protective treatment quickly permeates the entire sapwood and brings heart-wood durability to the surface—top to butt! Though deadly to insects and decay organisms, Life-Span treated poles are completely safe for cattle, horses and other farm animals.

For strength...for safety...for longer life...specify LIFE-SPAN Cedar Poles!

Life Span



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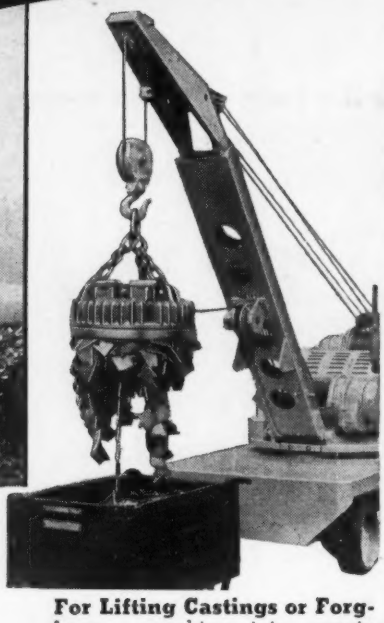
LIFE-SPAN

CONSOLIDATED TREATING CO.

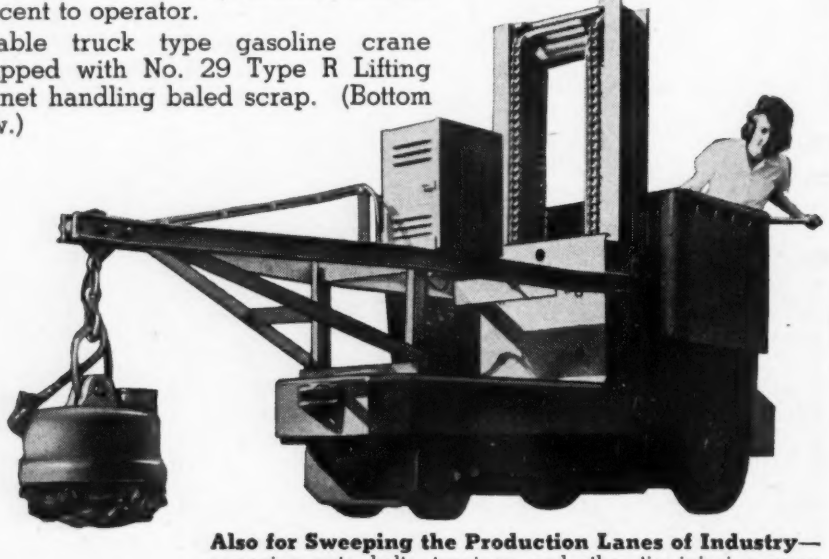
MINNEAPOLIS, MINNESOTA

For Lifting Loose or Baled Scrap—a mobile unit. Boom can be retracted and lowered to enter box cars for loading or unloading finished material. 36-volt power-generating unit on truck crane supplies direct current for this 29-inch diameter magnet. "Lift" and "Drop" push buttons are conveniently located adjacent to operator.

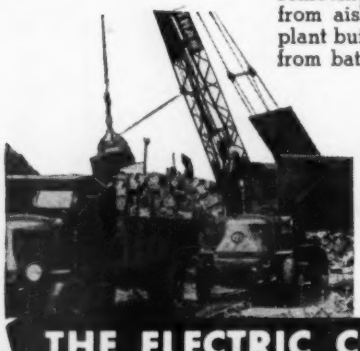


For Lifting Castings or Forgings — reaching into remote corners of a plant, this 29-inch magnet receives power directly from crane truck.

Portable truck type gasoline crane equipped with No. 29 Type R Lifting Magnet handling baled scrap. (Bottom View.)



Also for Sweeping the Production Lanes of Industry—removing nuts, bolts, turnings, and other tire-injuring scrap from aisleways, between machines, from roadways, between plant buildings, etc. This 18-inch diameter magnet is operated from battery of standard high-lift truck.



EC&M Magnets Come in 10 Sizes for All Needs. Bulletin 900 gives complete data and shows many interesting installations. Bulletin 910-2M gives road-sweeping magnet information. Send for copies.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79th STREET • CLEVELAND 4, OHIO

ignition system. Another control, Flame Rod type 45JP1, may be added if it is desired to monitor the gas pilot flame as well.

The photoelectric scanner is reported compact in design and readily installed on the burner plate either at the time of assembly of the original burner equipment or upon installation in the field. Since the scanner contains both the phototube and amplifier tube, no special shielded cable is required between the scanner and programming control, the company reports. The photoelectric system is designed to withstand conditions of relatively high ambient temperature and is impervious to ambient humidity, it is reported. Equipment may be installed on 115- or 230-volt, 60-cycle circuits and has a power consumption of 20 watts.

•

Mercury Switch Designed To Save Space in Mechanisms

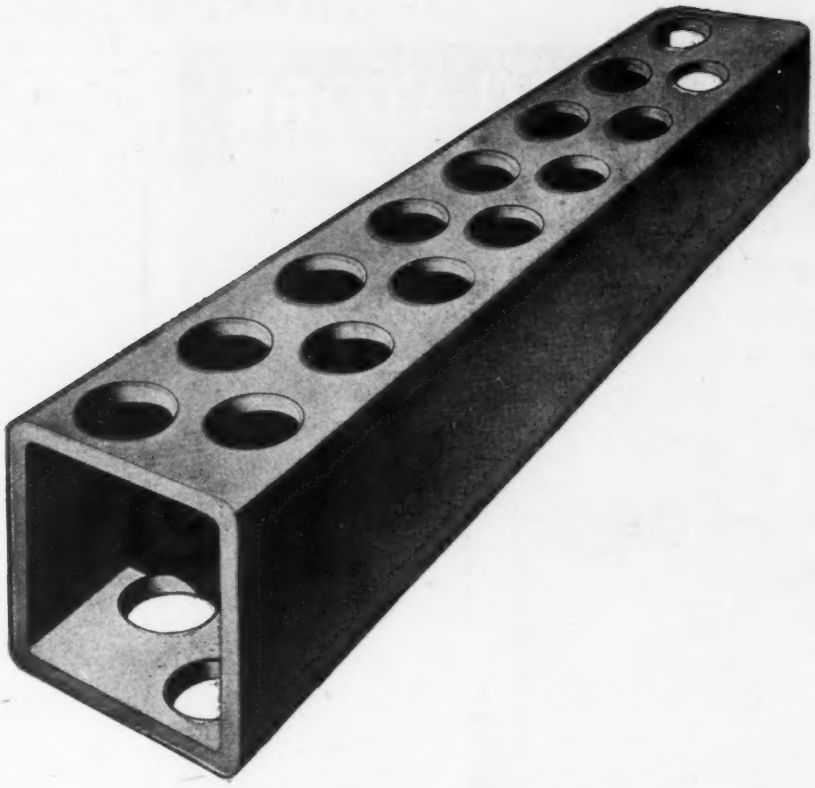
A NEW mercury switch, less than an inch and a half in length and rated at 1 amp. at 115 volts, a.c., has been developed by Minneapolis-Honeywell Regulator Co., 2953 Fourth Ave. South, Minneapolis 8, Minn. It was designed primarily to save space in switch action mechanisms, the manufacturer reports. The new switch is actuated by a snap tilt of 12 deg. and is of the single-pole, single-throw type. Production on the new switch, Model AS-408D, has been started and large-scale deliveries are scheduled for later in the spring.

•

Coaxial Cable Design Saves Materials Cuts Costs

A NEW shielded FM and television lead-in line, which is stated to have a high signal to noise ratio, to be flexible and fireproof, has been developed by Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. Combined with these characteristics, the manufacturer reports, is the factor of low attenuation.

The cable, called ATV150 Shielded, is of the flat oval type consisting of twin parallel stranded bare copper conductors (7 x No. 28), polyethylene insulation, bare copper braid, and a Densheath jacket. The design is stated to permit conservation of both insulation and jacket material, and thereby to provide a cable less costly than stand-



Simple One-Piece Construction *plus*—

in CHASE SQUARE *Copper* TUBE

HERE's a bus conductor that's *easy to install.* The rigid, one-piece construction of Chase Square Copper Tube requires no auxiliary clamping devices. This saves installation time and labor.

But that's not all. When you specify Chase Bus Conductors for your AC bus installations you get, in addition, such valued features as great mechanical strength and high current-carrying capacity.

A square copper tube gives maximum strength (per pound of copper) in all directions...while ventilating holes in both top and bottom faces of the tube increase current-carrying capacity, and help conserve copper.

Get the details. Send for the Chase Electrical Handbook. It contains complete information about Ventilated Square Tube and other Chase bus conductor forms. For complimentary copy, address Department EW-37A.

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Waterbury 91, Connecticut
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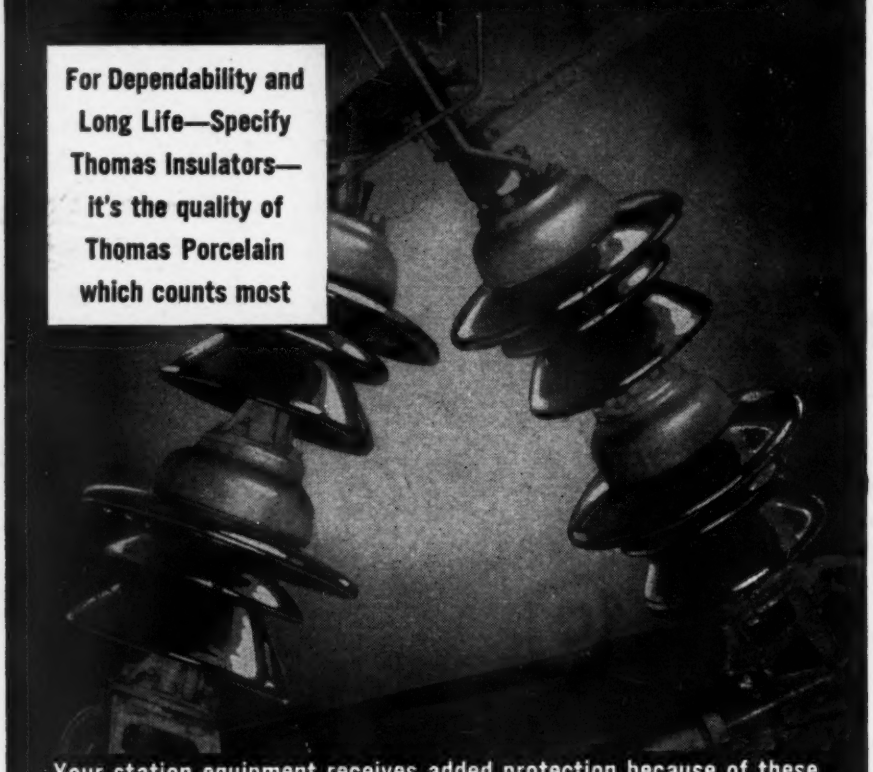
This is the Chase Network—handiest way to buy brass

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS JACKSONVILLE† KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON† (†Indicates Sales Office Only)

THOMAS INSULATORS
FOR SWITCH AND BUS SUPPORTS

For Dependability and Long Life—Specify Thomas Insulators—it's the quality of Thomas Porcelain which counts most



Your station equipment receives added protection because of these outstanding features of Thomas Switch and Bus Insulators

- Each unit meets EEI and NEMA basic insulation standards, and also offers the plus value of Thomas patented "Quiet-Type" radio noise free protection where necessary—at no extra cost.
- A complete size range is offered for every practical voltage application. Each insulator is carefully made, tested and approved under the experienced supervision of skilled craftsmen and engineers.
- To accomplish absolute uniformity and precision, utmost care is taken in assembling these insulators in heavy, fully machined jigs. Consequently, apparatus can be designed and assembled ready for the insulators without fear of major adjustments to clearances and alignment being necessary. Perfect alignment is maintained and precise interchangeability of units guaranteed.
- Balanced Electrical, Thermal, and Mechanical characteristics account in a large way for the longer life and unexcelled performance of Thomas Porcelain under all conditions.

THE R. THOMAS & SONS CO.
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Please send me your Catalog No. 40 illustrating Porcelain Insulators and Line Hardware for Distribution Lines.

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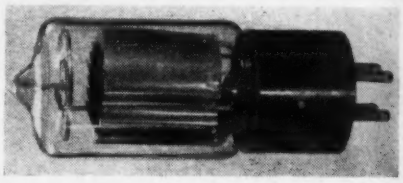
ard round coaxial designs. The manufacturer reports that, in general, its use will eliminate the need for a matching section between dipole and receiving set as the 150-ohm line in multiples of a quarter length wavelength will act as a matching section. It is reported as applicable as a lead-in cable in congested areas, or where there may be excessive electrical interference, as well as in wiring certain circuits in receiving sets which require a shielded, balanced line with low mutual conductance between conductors. It is available for immediate delivery.

•

Grid Control Rectifier Tube Xenon Filled

A NEW GRID CONTROL, Xenon-gas-filled rectifier tube has been announced by Electrons, Incorporated, 127 Sussex



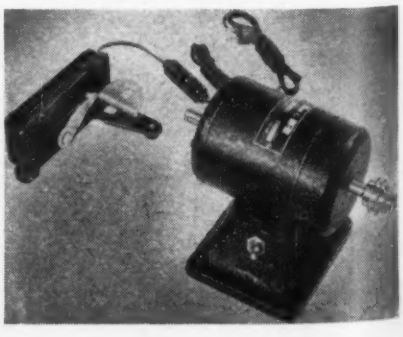
Ave., Newark 4, N. J. The tube, known as type EL CIJ, may be used for motor speed control, servo amplifiers, high speed or synchronous switching circuits, and high speed counting or inspection circuits.

Among characteristics reported are: average anode current, 1.0 amp. d.c.; peak anode current, 8.0 amp. d.c.; maximum peak inverse voltage, 700; average arc drop, 8 volts; filament voltage, 2.5; filament heating time, 40 sec., and over-all length, 4½ in.

•

New Motor Is Rated At 1/10 Hp. at 5,000 Rpm.

PRODUCTION of a new general purpose universal motor which is rated 1/10 hp. at 5,000 rpm. has begun at the L & R Manufacturing Co., 577 Elm St., Arlington, N. J. The manufacturer reports the unit features a spindle with a ⅜-in. shaft extending in both direc-



ARE YOUR WIRE NEEDS *Standard or Super Special?*

No matter how you use it, wire or cable insulated with PLASTICON will serve you better because of one or more of PLASTICON'S ten basic characteristics.

The user of "special" wire benefits particularly because hitherto impossible specifications are being met to the letter in PLASTICON products developed to specific applications by the engineers of America's largest exclusive manufacturer of plastic wire and cable products.

For instance one of America's leading manufacturers of hearing aids, who depends on PLASTICON for strength, flexibility, and exact coloring. Or the largest producers of heat regulating devices, who use a specially developed PLASTICON wire.

Wire or cable is better if it is plastic insulated, because of the superior adaptability of plastic. Plastic insulation is at its best if it's PLASTICON, the trade name of Plastic Wire & Cable Corporation. Write for free booklet of technical data on PLASTICON insulation, and explain your requirements, or let us tell you how we can meet them with PLASTICON.

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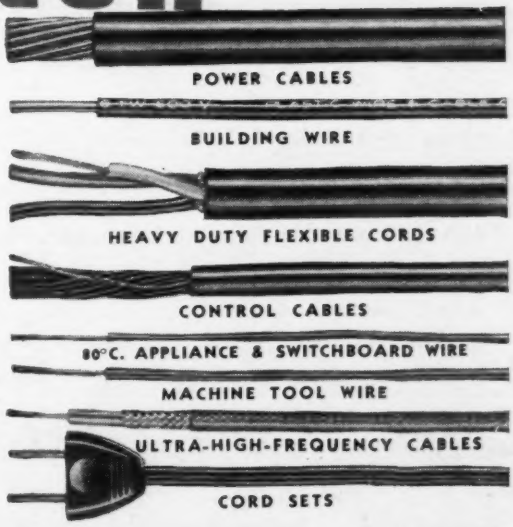
PLASTICON 10 WAYS BETTER

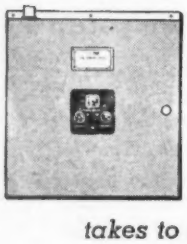
1. *Greater Dielectric strength.*
2. *Cannot fray, crack or rot.*
3. *Low moisture absorbtion.*
4. *Greater mechanical strength.*
5. *Higher abrasion resistance.*
6. *Flexibility at all temperatures.*
7. *High chemical resistance.*
8. *Wide range of permanent gem-like colors.*
9. *Non-combustible.*
10. *Lasting appearance.*



PLASTIC WIRE & CABLE CORPORATION, 407 East Main Street, Jewett City, Conn.

NOSE of a Bloodhound

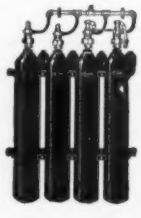
SPEED of a Tiger



That's the New Underwriters' Approved Smoke Detector

A wisp of smoke from a faintly smoldering fire is all it takes to operate a C-O-Two Smoke Detector. The Detector sniffs air ***continually*** *from all protected areas. If smoke is present, an alarm sounds and, like a tiger, a C-O-Two fire extinguishing system springs into action; the fire is smothered in seconds with a cloud of cold, dry, inert carbon dioxide gas. A few minutes later the area is ready for use again; no after-fire clean-up is necessary. Carbon dioxide won't harm finishes, fabrics or equipment. It is a non-conductor and can be used safely on live electric equipment. Snuffs out flammable liquid fires.*

Investigate this new and modern method of detecting and extinguishing fire at its start. C-O-Two Smoke Detectors are not dependent on heat for operation. They are especially designed for fast detection of slow smoldering fires in record vaults and storage spaces.



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Sales and Service in the Principal Cities of United States and Canada

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tions and double shielded ball bearings that never require oiling. Outside diameter of the motor is 3¼ in. It is pedestal mounted, is supplied with a 3-step pulley, a foot rheostat and a reversing switch. It is presently available in limited quantities.

•

Three Air-Conditioning Units Are Self-Contained

MANUFACTURE of newly designed self-contained air-conditioning units for installation in retail stores, candy shops, restaurants and other commercial establishments, has begun at the Sturtevant Division of the Westinghouse Electric Corp., Hyde Park, Massachusetts.

Being made in 2-, 3- and 5-hp. sizes, the units have been reduced as much as 15 percent in size as compared to pre-war models with similar capacities, the company reports. The new models also are as much as 20 percent lighter, it is stated. Each of the cabinet-enclosed units, called a Unitaire, contains all the component parts to perform the various functions of air conditioning. This includes compressor, condenser and evaporator for cooling and dehumidifying, glass wool filters for cleaning and a fan for circulation. A heating coil and humidifiers may be added to furnish year-round air conditioning.

The 2-hp. model conditions up to 800 cu. ft. of air every minute, the 3-hp. model up to 1,200 cu. ft. and the 5-hp. size, 2,000 cu. ft.

The two smaller units are built into the same size cabinet, finished in semi-gloss two-tone gray enamel and standing 68 in. high, 36 in. wide and 22 in. deep. The 5-hp. model is 77 in. high, 44 in. wide and 22 in. deep. Parts are mounted on a rigid steel chassis, with panels easily removable to facilitate inspection and servicing without moving the unit. The hermetically sealed compressor and fan assembly are mounted on rubber to isolate vibration.

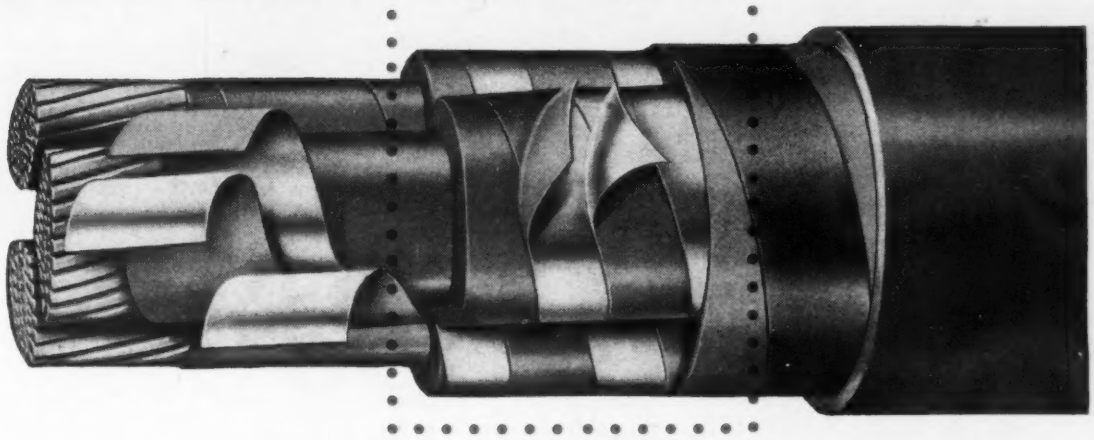
TECHNICAL LITERATURE

Terminals—A new publication, MS-6, 1946, "Specification for Marking and Arrangement of Terminals for Phase-Shifting Devices Used in Metering," has been released by Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y. The specifications have been approved by the committee on metering and service methods, Association of Edison Illuminating Companies, and the meter and service committee of the Institute.

Sales Positions—A report of the sales personnel and training committee, commercial division, E.E.I., publication 0-16, 1946, is available from Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y. The report, entitled "Position

NO EXTRA METALLIC TAPE SHIELDING

NEEDED HERE



When Your Power Cables are Protected with the NEW K-D Metallized Paper Tape

IT'S NEW, it's better, it's available now—a stronger metallized paper tape by Keller-Dorian that eliminates the need for the usual supplementary metal shield over conductor insulations in paper insulated power cables!

Keller-Dorian Metallized Paper Tape already has proved itself as a shielding between conductor and insulation, and also—intercalated with a metal shield—between conductor insulations and outer sheath. Now, in addition to its standard advantages, the new K-D tape means savings in over-all cable weight, easier handling . . . and at no sacrifice in cable reliability, no increase in initial cost.

The new tape is undamaged in the cabling process, and maintains a tight, constant contact between insulation and sheath. Behind it lies years of experience in Europe, where this practice has been standard for many years on "screened" cables.

Ask your cable manufacturer how your paper insulated cables can give you better performance at reduced annual cost . . . when you specify Keller-Dorian Metallized Paper Tape protection.

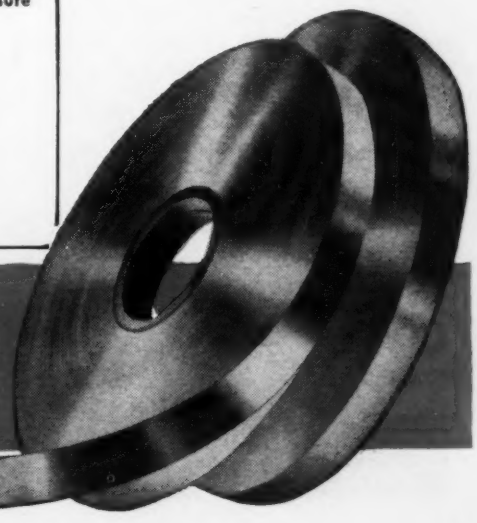
NOW—9 ADVANTAGES:

Keller-Dorian Metallized Paper Tape in paper insulated cables gives you these results:

1. **Higher dielectric strength**
2. **Elimination of electrical stress concentration**
3. **Improved power factor**
4. **Reduced ionization**
5. **Barring of moisture diffusion on exposure**
6. **Short-circuiting of sheath voids**

PLUS

7. **Elimination of metal shield**
8. **Less over-all cable weight**
9. **Easier handling of cable**



KELLER-DORIAN
CORPORATION
EMPIRE STATE BUILDING • NEW YORK 1, N. Y.

METALLIZED PAPER TAPES FOR ELECTRICAL CABLES

Crapo
STEEL CONDUCTORS

Because of its high tensile strength, its ruggedness and its conductivity, *Crapo* HTC-130 Steel Conductor is both practical and economical as an overhead ground wire. Its superior strength makes possible long spans with flat sags and greater clearances. Its rugged physical characteristics give it a high fatigue endurance limit, enable it to withstand severe shock and deformation.

The all-'round dependability and economy of *Crapo* HTC-130 Steel Conductor as an overhead ground wire have been established by its performance under actual operating conditions. Leading utilities have adopted it on the basis of their own experience.

• • •

Crapo Steel Conductors are distributed by Graybar Electric Company, Inc. Ask the Graybar representative or write for your copy of the *Crapo* Steel Conductor Manual!

Crapo HTC-130 Steel Conductors for overhead ground wires are available in Standard (3-wire) and Solid types. Physical properties for sizes No. 4 and No. 6 (B.W.G.), in both types, are shown below:

Conductor Size B. W. G.	Type of Construction	Diameter of Conductor (inches)	Minimum Breaking Strength (lb.)
4	3-wire	0.297	5610
6	3-wire	0.252	4295
4	Solid	0.238	5784
6	Solid	0.203	4208

INDIANA STEEL & WIRE COMPANY
MUNCIE, INDIANA

Descriptions for Eight Utility Sales Jobs," covers outside residential appliance salesman, residential lighting advisor, home service advisor, residential dealer coordinator, commercial salesman, outside power representative and farm service representative.

Metallizing—Collection of technical and operating data on the metallizing process is contained in a new handbook available from the Metallizing Engineering Co., Inc., Long Island City 1, N. Y. It contains data on preparation of the surfaces, metallizing technique, finishing procedure, complete data on corrosion resistance, specific gravity, hardness, bond strength, tensile strength, and relative shrink. It is profusely illustrated and is available at $2.00 per copy.

Lamps—A 76-page technical treatise, Bulletin No. LD-1, which contains data collected from previously published material, has been issued by General Electric Co., Nela Park, Cleveland, Ohio. The material is presented to answer many of the questions on design, application and economics of incandescent, fluorescent and mercury light sources. Copies are available at a cost of 40 cents each.

Demand Meters—Specifications for Indicating Thermal Watt Demand Meters, MS-5-1946, which has been approved by committee of metering and service methods, Association of Edison Illuminating Companies and the meter and service committee, Edison Electric Institute, is available from E.E.I., 420 Lexington Ave., New York 17, N. Y.

Transformer Oils—A 110-page bulletin, entitled "General Discussion on Transformer Oils," containing eight papers on the subject is available from the Institute of Petroleum, 26 Portland Place, London, England for 7s. 6d. each.

Code—An analysis of the revisions made in the 1940 National Electric Code which are incorporated in the 1947 edition is available from the National Electric Manufacturers Association, 155 East 44th St., New York 17, N. Y. The analysis was made by Arthur L. Abbott, is 4½ x 6¾ in. in size, and contains 144 pages. Single copies are priced at 50 cents and ten or more copies are priced at 30 cents each.

Gas Turbines—A publication, "Symposium on Materials for Gas Turbines," is available from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., for $3.00 per copy. The 200-page bulletin contains discussions on properties of metals and alloys usable in this type of equipment.

FILM REVIEWS

The Pound Cure—A 35-mm. sound slidefilm, which describes and defines static and dynamic unbalance and the means of restoring both, is being distributed by the industrial division, Bear Mfg. Co., Rock Island, Ill.

"Look to Leader" is the title of a 12-minute sound film recently completed by Leader Electric Mfg. Corp., Chicago. The film is designed to assist public utility executives, contractors, wholesalers, architects and builders. Keyed market-wise, the film covers the potential lighting markets existing today, trends in fluorescent lighting as well as the company line and field services. Company representatives are being provided with projectors to show the film to interested groups and individuals.

NEWS ABOUT PEOPLE

F. J. Fishburne Assumes New Engineering Duties

F. J. Fishburne, chief dispatcher for the South Carolina Power Co., Charleston, for the past five years, has been

F. J. FISHBURNE

appointed transmission superintendent. He will be in charge of operations and maintenance of transmission lines and substations. Mr. Fishburne succeeds E. E. Cambron, veteran employee, who died last December. William E. LeCroy has been appointed to succeed Mr. Fishburne.

A graduate of Clemson College, with a B.S. degree in electrical and mechanical engineering, Mr. Fishburne obtained his early practical engineering experience with the Alabama Power Co. He then joined South Carolina Power in 1929 as statistical engineer. Following four years in military service he returned to the Charleston utility.

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▶ CHARLES E. SCHEER, superintendent of the Stryker, Ohio, municipal light and power plant since 1937, has resigned to become chief engineer of the Montpelier, Ohio, municipal light and water plant.

▶ L. B. LOCKLIN, formerly superintendent of Plant Atkinson, Georgia Power Co., has been made assistant superintendent of production of the company. Succeeding Mr. Locklin in charge of Plant Atkinson is R. S. CAUSEY, who has been promoted from the position of assistant superintendent. C. D. EISENMAN formerly chief electrician in north Georgia, has been made assistant superintendent of that area's hydroelectric plants.

•

S. Rosenbach Gets New Engineering Assignment

Samuel Rosenbach has been appointed general engineer in the electrical engineering department of the Duquesne Light Co., Pittsburgh, to succeed E. R. Whitehead, who recently left the company to become research profes-

S. ROSENBACH

sor of electrical engineering at Illinois Institute of Technology.

Mr. Rosenbach's new duties will include special and general engineering studies and investigations, study of material and equipment, and preparation of specifications and standards.

Mr. Rosenbach entered the employ of the Duquesne Light Co. in 1922, and has served in the capacity of junior engineer, senior engineer, district engineer, field engineer and distribution engineer, the position he held at the time of his present appointment. He is a member of the A. I. E. E.

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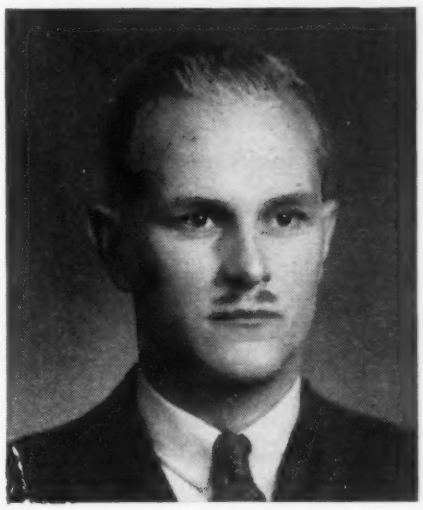
▶ C. JACK JONES of Bremerton has been elected president of the Washington State Public Utility Commissioners Association.

Shawinigan Utility Appoints Mainguy Vice-President

W. F. Mainguy, formerly personnel manager of the Shawinigan Water & Power Co., Montreal, has been appointed vice-president in charge of distribution of the company.

Mr. Mainguy has been with the company since 1928 when he was employed as a draughtsman with the company's engineering subsidiary, the Shawinigan Engineering Co., Ltd. In 1932 he was



W. F. MAINGUY

appointed power sales engineer of the commercial and distribution department of Shawinigan Water & Power Co., becoming power sales manager of that department in 1937. In 1942 he was appointed personnel coordinator and later personnel manager.

T. P. Dalton has been made personnel manager, succeeding Mr. Mainguy.

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▶ DR. HOMER D. HOLLER, well known chemist and one of the leading authorities in the field of underground corrosion, has been appointed to the staff of the National Bureau of Standards. Dr. Holler, who has directed pioneering studies in electrochemical and corrosion work in two former tours of duty at the Bureau, will work with Dr. I. A. Denison of the underground corrosion section. He joins the Bureau's staff from the Westinghouse Electric Corp., where he has been responsible for corrosion investigation and control since 1929. Dr. Holler is a member of the

Electrochemical Society, the American Chemical Society and the National Association of Corrosion Engineers.

•

Overstreet Made Central Division Manager in Boise

R. S. Overstreet of Boise has been named manager of the Idaho Power Co.'s central division, with headquarters

R. S. OVERSTREET

at Boise. J. W. Crowe, who has been manager of the central division 30 of the 33 years he has been with the company and who is now eligible for retirement, will continue with that utility through 1947 to carry out and complete the numerous activities he has in progress and to assist Mr. Overstreet in establishing himself as division manager.

Mr. Overstreet, who has been sales manager in the general office for the past five years, joined Idaho Power Co. 19 years ago. All his work has been in the sales department. When the rural service department was organized, he was the company's rural sales representative at Parma. Six months later he moved to Boise to become agricultural engineer in the sales department and then transferred to the central division as its sales manager. Five years ago he was named sales manager for the company.

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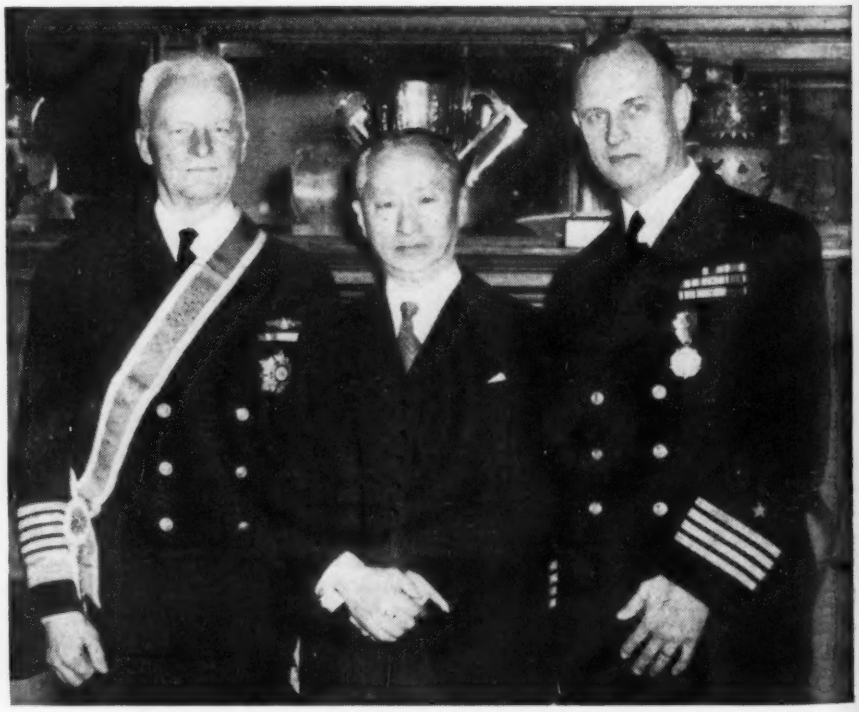
▶ T. A. BURDESHAW, formerly assistant sales manager of Southern States Equipment Co., Hampton, Ga., has been made sales manager for the electrical division. C. W. WALKER has been made sales manager for Henderson Foundry division of the company. TOM M. SALISBURY, formerly general sales manager, is now vice-president and general manager of Industrial Suppliers, Inc., Jackson, Miss.

▶ R. C. SOGGE, formerly assistant manager of General Electric Co.'s general station divisions, has been appointed manager of the standards division and LEE F. ADAMS, standards division manager, has been made standards consultant. The appointments will permit Mr. Adams to devote the necessary time to his duties as president of the U. S. National Committee of the International Electrotechnical Commission and as vice-chairman of the Standards Council of the American Standards Association. Mr. Adams first became associated with G.E. in 1906 and with the exception of two years as an instructor at his alma mater, Pennsylvania State College, he has been connected continuously with General Electric in the induction motor engineering, industrial engineering, commercial general and standards divisions. Mr. Sogge, who as assistant manager of the central station divisions has been connected with establishing price policy of central station apparatus, has been associated with General Electric since 1916.

▶ J. FRANK WARD, Puget Sound district manager for the Bonneville Power Administration with offices at Seattle, Wash., has been appointed superintendent of Tacoma City Light. The position has been vacant since last summer. Mr. Ward has been connected with engineering and construction work since 1918.

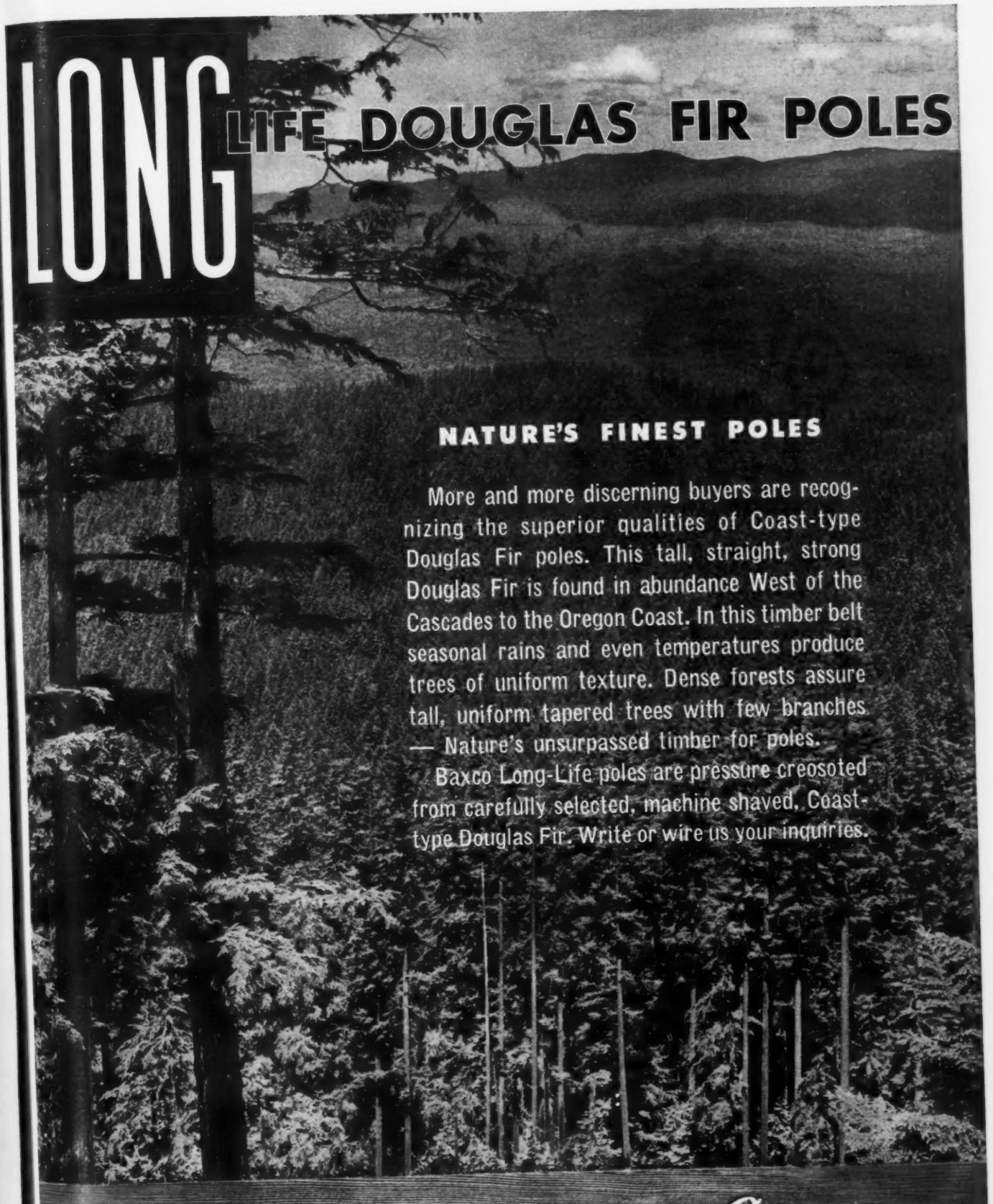
▶ MALCOLM MACNAUGHT, manager of ELECTRICAL WORLD, whose plans to open an advertising agency were announced in ELECTRICAL WORLD recently, has relinquished this project. Mr. MacNaught will remain with the McGraw-Hill Publishing Co. as associate district manager, Atlantic District Sales Department.

▶ ROY E. HAYMAN has joined the Chickasha staff of the Public Service Co. of Oklahoma as agricultural development engineer. He will assist in conducting the company's program on rural development in the southwestern division. Mr. Hayman has a broad background of experience in rural electrification work. After spending four years at the Oklahoma A. & M. College studying electrical engineering, Mr. Hayman was employed by the Oklahoma Gas & Electric Co., where he set up the safety department and served as safety engineer for one year. For the following 18 years he was manager of the rural service department. Mr. Hayman has



HONORED BY CHINA—Capt. Hoyt S. Scott (USNR), right, illuminating engineer at General Electric's Nela Park, Cleveland, was honored recently at Washington, D.C., by the Republic of China. He is shown here with U. S. Fleet Admiral Chester W. Nimitz and V. K. Wellington Koo, Ambassador from China to the U.S. Capt. Scott was decorated with the Army-Navy Air Distinguished Service Medal "for exceptionally meritorious services to the Government of the Republic of China as communications engineer of the Friendship Project . . . "

LONG LIFE DOUGLAS FIR POLES



NATURE'S FINEST POLES

More and more discerning buyers are recognizing the superior qualities of Coast-type Douglas Fir poles. This tall, straight, strong Douglas Fir is found in abundance West of the Cascades to the Oregon Coast. In this timber belt seasonal rains and even temperatures produce trees of uniform texture. Dense forests assure tall, uniform tapered trees with few branches — Nature's unsurpassed timber for poles.

Baxco Long-Life poles are pressure creosoted from carefully selected, machine shaved, Coast-type Douglas Fir. Write or wire us your inquiries.

J. H. Baxter & Co.

333 MONTGOMERY ST., SAN FRANCISCO
601 W. FIFTH ST., LOS ANGELES
Associated Company • J. H. BAXTER & CO. of OREGON
EUGENE, OREGON

MANAGEMENT and PRODUCTION men want

FACTS

about equipment they buy

Here are FACTS about

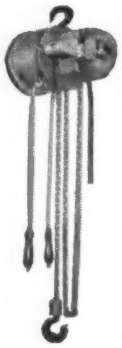
Coffing Hoists

"SAFETY-PULL"
Ratchet Lever Hoists

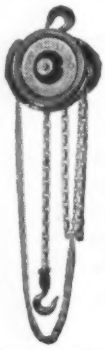
For all kinds of construction and maintenance work, wherever a lift or pull is needed, there is a "Safety - Pull" to meet your requirements. SAFE, DURABLE, DEPENDABLE. Capacities range from ¾ to 15 tons, yet they weigh only 14 to 150 pounds.

"QUIK-LIFT"
Electric Hoists

For dependable and economical service the "Quik - Lift" incorporates EFFICIENCY with SPEED, POWER and DURABILITY. Just plug it in and speed up production. Capacities from 500 to 4000 pounds with lifting speeds from 4 to 49 feet per minute.



MODEL Y-C
Spur Geared Chain Hoists



Coffing Spur Geared Chain Hoists embody the planetary gear system with the Weston automatic brake. There are seven capacities ranging from ½ to 5 tons. A sturdy, dependable hoist for heavy work and in the production line.

Contact Your Supplier or Write for BULLETIN EC-100

Coffing Hoist Co.
Danville, Illinois U. S. A.

served as chairman of the farm utilization equipment committee of the Edison Electric Institute and for four years was chairman of the Southwestern section. He is also a member of the American Institute of Electrical Engineers.

▶ Dr Enrico Fermi, physicist at the Nuclear Research Institute in Chicago. has been made the recipient of the 1947 Franklin Medal, highest honor of the Franklin Institute, for outstanding work in the field of atomic energy.

▶ William E. Casey, acting manager of the Lawrence (Mass.) Gas & Electric Co. since September, 1946, and formerly assistant manager of the Worcester County Electric Co., has been appointed vice-president and manager of the Lawrence company, succeeding Robert H. Patterson, who has been transferred by the New England Power System to the position of executive assistant to the president of the Malden Electric Co., who has general supervision over the North Shore, Northeastern and Mystic Valley districts of the System.

▶ W. H. Brown has been appointed assistant general manager of the Hoskins Manufacturing Co., Detroit, and A. E. Little has been named assistant sales manager. Mr. Brown, who joined the company in 1939 after four years with the Ford Motor Co., has heretofore had charge of production and employee relations. A graduate of the University of Michigan, Mr. Little went directly to the Westinghouse Electric Corp. at East Pittsburgh, where he spent two years in the shop followed by four years in the Detroit sales office. After release from service in the Navy, he joined Hoskins in 1945.

▶ Harold S. Silver has been named general patent attorney in charge of the patent department, legal division, Allis-Chalmers Mfg. Co., Milwaukee, Wis. He succeeds the late J. J. Kane. Mr. Silver has been associated with Allis-Chalmers since 1933 and prior to that was with the United States Patent Office.

▶ Dr. W. A. Johnson, manager of the metallurgical section of the Westinghouse Research Laboratories, has been selected to set up and direct a new metallurgical division of the Clinton Laboratories at Oak Ridge, Tenn., in connection with military and peace-time applications of atomic energy. Dr. Johnson became the eleventh Westinghouse man to join the pool of scientific manpower working at Oak Ridge to harness atomic power for peace-time applications. Dr. Johnson has been granted a year's leave of absence by Westinghouse.

▶ Roy Wensley has been appointed general manager of the Wilcox-Gay Corp., Charlotte, Mich. Mr. Wensley brings to the Wilcox-Gay Corp. a broad and varied experience in the fields of engineering and electrical manufacturing. From 1916 to 1935 he was identified with the Westinghouse Electric Corp. in engineering capacities, principally with switchgear, refrigeration and electrical relays. In 1935 he was appointed assistant general manager of I-T-E Circuit Breaker Co., Philadelphia, and was advanced to general manager in 1941. Mr. Wensley is a member of the American Institute of Electrical Engineers and of the Institute of Radio Engineers.

▶ Paul M. Ross, who has been connected with the Ohio Brass Co. since 1934, has recently been transferred to the sales department as consulting engineer. Mr. Ross was engineer in charge of high-voltage impulse testing at the Barberton laboratory, and in 1937 was appointed superintendent of the high-voltage laboratory at the Barberton plant. He is a member of the American Institute of Electrical Engineers and in addition to serving as a member of the committee on basic standard test code covering impulse, low frequency and d.c. testing, he has worked with the standard Number 4 committee. Mr. Ross has also worked with the power switching equipment group of the National Electrical Manufacturers Association and the high-voltage insulator section.

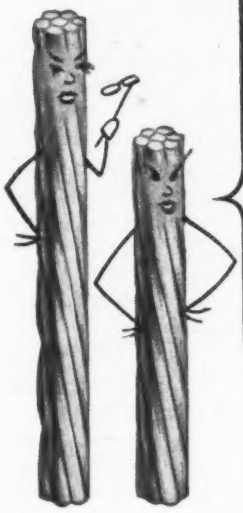
OBITUARY

▶ Floyd Thompson, superintendent of the steam plant of the Lockport Division, New York State Electric & Gas Corp., died suddenly on March 15 of a heart attack while attending a meeting in Binghamton. Mr. Thompson was born in Luverne, Pa., 46 years ago and had been employed by the utility since 1920.

▶ W. Green, manager of the Texas Power & Light Co. at Denison, Tex., for 23 years, died on March 1 in a local hospital. He had been ill with a heart ailment for the past few years. Mr. Green entered the utilities field in 1908 when he joined the staff of the Denison Light & Power Co. as a clerk and was appointed district manager when the Texas Power & Light Co. purchased the Denison utility in 1918. He continued in that capacity until his retirement in 1941.

▶ Karl C. Mason, 55, general superintendent of the Brockton (Mass.) Edison Co., died suddenly at East Bridge-

What's She Got That We Haven't Got?



Why, the answer is bethanized coating, of course. And in this case, beauty is more than skin-deep.

For a bethanized coating gives vital protection to your Bethlehem strand—protection against the corrosive effects of moisture, smoke, and acid fumes. And it's so ductile it virtually eliminates the hazards of checking, peeling, and flaking.

Bethanizing is an exclusive Bethlehem process of zinc-coating wire. The protective "armor" is applied electrolytically by a method that does not impair the desirable physical properties of the base wire. This coating is available in A, B, and C weights—you pick the one that best meets corrosive conditions in your particular area.

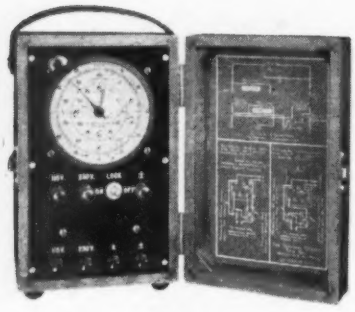
Remember, Bethlehem strand is the *only* strand that is furnished with a bethanized coating.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation

FOR RELIABLE RELAY TESTING . . .

use a *Standard* Portable



CYCLE COUNTER

STANDARD MODEL AC-1
Portable Tester for high speed relays, welding timers, and process timers.

Tried, approved, and used by electric light and power companies everywhere, Standard Cycle Counters provide a positive method for testing the operating time of overload and under-voltage relays. Indicating and totalizing hands, controlled by an electro-magnetic clutch, measure time intervals by quarter cycles from ½ cycle upward for circuit opening and circuit closing relays. Heavy-duty synchronous motor . . . walnut finish case . . . weighs only 6 lbs. . . . available in 60 cycle, 115-230 volts, 50 cycle, 115-230 volts, or 25-60 cycle, 115 volt models.

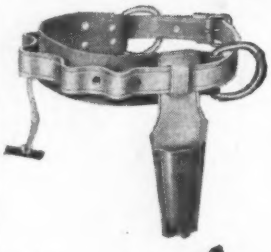
THE *Standard Electric Time Co.*

SPRINGFIELD 2 STANDARD FOUNDED 1884 MASSACHUSETTS

A *Rugged* COMBINATION

S-T-R-A-U-S-S KKB151

packed with Protection for Linemen



NO. 36PP LINEMEN'S SAFETY BELT

Constructed of prime oak harness leather with explicit exactness given to every manufacturing detail. Hardware, including Dees and buckle, is drop-forged and fully tested. All rivets are solid copper, hand set. Stress points are completely reinforced.

NO. 163 LINEMEN'S SAFETY STRAP

Equally well constructed as its companion belt, this oak tanned steerhide safety strap is not the least of this rugged combination. Its "known strength" qualities have been conscientiously controlled by the addition of copper plate reinforcements at the buckle. It's a "top quality" product that gives first class performance.

The Portable Safety Division manufactures a complete line of Strauss linemen's safety equipment with both web and leather construction. Write for full details.

PORTABLE SAFETY DIVISION

PORTABLE PRODUCTS CORPORATION

420 BLVD. OF THE ALLIES, DEPT. 4F, PITTSBURGH 19, PA.

water, Mass., on March 16. He was a native of Keene, N. H., and was graduated from the Massachusetts Institute of Technology in 1914, when he joined the staff of the Brockton company. He was active in the New England System Operators Club.

▶ ROSCOE WILMETH, technical superintendent of the Sangamo plant of the Sangamo Electric Co., Springfield, Ill., died on March 4 in the company's hospital. Mr. Wilmeth, who was 50 years old, was stricken while at work. He was a member of the engineering staff of Sangamo Electric for more than 20 years and was honored by the company two years ago as being one of its outstanding engineers.

▶ BENTLEY W. WARREN, a director of the Holyoke (Mass.) Water Power Co. and counsel for Massachusetts in the celebrated water diversion case involving the Ware and Swift Rivers in that state and its effect on the Connecticut Valley, died at Boston, Mass., on February 27. For many years Mr. Warren was prominent in electric transit legislative affairs and was an outstanding authority on constitutional law.

▶ EDGAR W. ADAMS, general patent attorney of Western Electric Co., died of a heart attack on March 10 at his home in Montclair, N. J. He was 62 years of age. A native of Baltimore, Mr. Adams joined Western Electric in New York as a patent attorney in 1912 and in 1945 became general patent attorney. Prior to his 1945 appointment, he filled the position of general patent attorney of the Bell Telephone Laboratories. Mr. Adams held nine patents on his own inventions in the communications field.

▶ ALBERT L. KNOX, 102, oldest annuitant of the Boston Edison Co., and for many years superintendent of the utility's general service plant on Massachusetts Avenue, Boston, until his retirement in 1930, died at Newton, Mass., on March 5. He entered the company's employ in 1900.

▶ SIDNEY W. ASHE, a retired electrical engineer, who had been identified with the General Electric Co. for a number of years, died on March 2 in New Lebanon, N. Y., at the age of 68. Born in New York, Mr. Ashe was graduated from Brooklyn Polytechnic Institute, where he later taught engineering for twelve years. Going to Pittsfield, Mass., in 1916, he became director of the educational and welfare department of the G. E. Pittsfield works. Mr. Ashe had extensive experience in technical writing and in safety work.

The Lighting Industry Exemplifies the Values in

PRODUCT CERTIFICATION

The meaning of the certification idea is quickly sketched by the experience of a group of reflector manufacturers who pioneered certification in 1919.

Working with incandescent lamp manufacturers, they developed a set of rigid specifications for their guidance. These specifications formed the basis of a test and certification program.

The product of each cooperating manufacturer was subject to periodic independent test.

Reflectors which, under test, met or exceeded the set of specifications were identified by a CERTIFICATION LABEL. This procedure, during the 28 years of operation has met with favor from reflector USERS and similar certification projects have been adopted by other groups. In each case the effect has been far-reaching, helping the manufacturer, the distributor, the user, and the electrical industry.

The labels identifyjng such projects are shown in the illustration above.

Know by Test

Label for Certified Lamp Makers

Label for RLM Industrial Fixtures

Label for Residence Fixtures

Label for Fluorescent Ballasts

Label for Fleur-O-Lier Fixtures

Label for Fluorescent Starters

Using above labels, the number of manufacturers having testing and certification contracts with ETL are:

RLM STANDARDS INSTITUTE 12	FLEUR-O-LIER MANUFACTURERS 27	CERTIFIED LAMP MAKERS 88
AMERICAN HOME LIGHTING INSTITUTE 19	CERTIFIED BALLAST MANUFACTURERS 7	CERTIFIED STARTER MANUFACTURERS 10

Results of Certification for the Welfare of the Electrical Industry

1. Specifications for manufacture that are really in the public interest.
2. Earnest efforts to produce good products that comply with the specifications.
3. Independent certification to the public of such compliance when this is proved by test.

The purpose of a certification is simply to provide at SMALL COST a means whereby the public recognizes the product to be of acceptable quality, uniform in manufacture, constructed to a standard in which it has confidence. This confidence being inspired since the qualities are based on *independent* investigation.

ETL provides the impartiality and technical skill to make certification a service to *help* all makers and users of lighting equipment.

ELECTRICAL TESTING LABORATORIES, INC.

2 EAST END AVENUE AT 79TH STREET • NEW YORK 21, N. Y.

Electrical Manufacturers Write Congress "Repeal 4-Cent Excise Tax on Copper"

Immediate and favorable consideration of the bill originated by Congressman James T. Patterson calling for suspension of the $80-a-ton excise tax on copper was requested this week by top executives of America's large copper and brass users.

Among these officials who already have written Congressmen were many prominent in the electrical manufacturing industry and included: George R. Beck, Aircraft-Marine Products Co., Harrisburg; F. C. Jones, president, Okonite Co., Passaic, N. J.; C. E. Wilson, president, General Electric Co.; C. O. Miller, director of purchasing, General Motors Corp.; Sosthenes Behn, president, International Telephone & Telegraph Corp.; Everett Morse, president, Simplex Wire & Cable Co.; Arthur Walsh, vice-president, Thomas Edison, Inc.; and H. D. Keresey, president, Anaconda Wire & Cable Co.

Many of these industrial leaders wrote Congressmen that there will be dire results if the excise tax is not suspended. Widespread unemployment and depletion of national resources can be expected, was added in some of the letters. George R. Beck, Aircraft-Marine Products, Co., wrote Congressman Knutson that many manufacturers would have to "price themselves out of business unless the excise tax was repealed."

Individual Views Expressed

F. C. Jones, president, Okonite Co., wrote, "Sixty-five percent of American copper production mined in this country is in the hands of two companies, namely, Kennecott and Phelps Dodge. Both of these companies own their own fabricating units both for wire and for cable and for brass and copper tubes, etc. While the owners and operators of both Kennecott and Phelps Dodge are honorable, fair American citizens, it is only human and natural that they are going to take care of their own fabricating units first, and as I have to compete with the wire and cable fabricating units of both these companies, what I would be able to buy from them would be what they have left over after taking care of their own fabricating needs."

He pointed out that of the remaining 35 percent, a large part was controlled by Anaconda Copper, which fabricates as well as mines the metal. Two Anaconda fabricating units, the American Brass Co. and the Anaconda Wire & Cable Co., also favor repeal of the excise tax, according to letters received by Congressman Knutson. Both Anaconda units reported inability to obtain sufficient domestic copper for their needs.

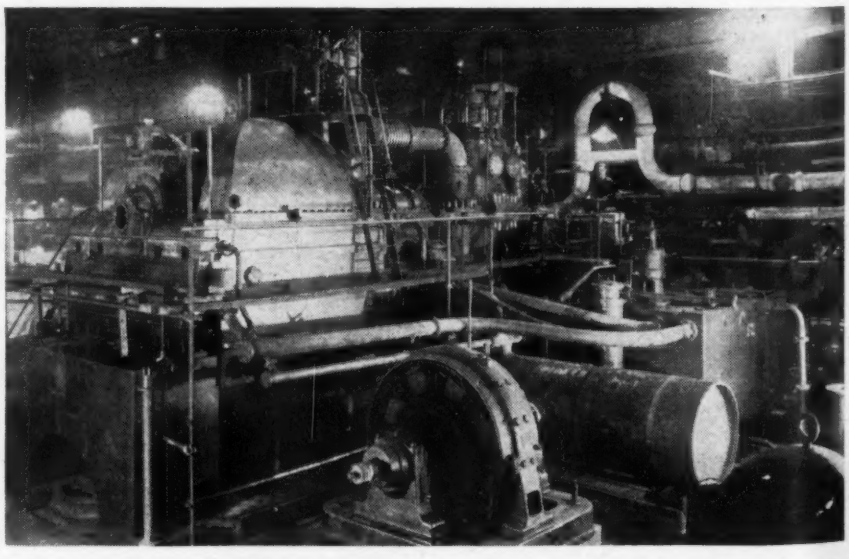
"Unless the copper tariff is removed, United States industry would not only have to pay $80 a ton on imports but also on domestic purchases," C. E. Wilson, president of General Electric Co., said in his letter to Congressman Knutson. "As soon as industry starts to purchase copper abroad, the domestic price would undoubtedly move up to the same level plus the four cents a pound tax. This would cost the American public in excess of $120,000,000 based on current consumption.

"If we were not able to get any imported copper, it would mean cutting back to about 60 percent of the present rate of production," the G. E. head's letter continued. "This would bring about an immediate and proportional reduction in employment."

C. O. Miller, director of the purchasing and salvage section of General Motors Corp. wrote the Congressman that he saw "no way by which an adequate supply of copper can be met out of domestic production.

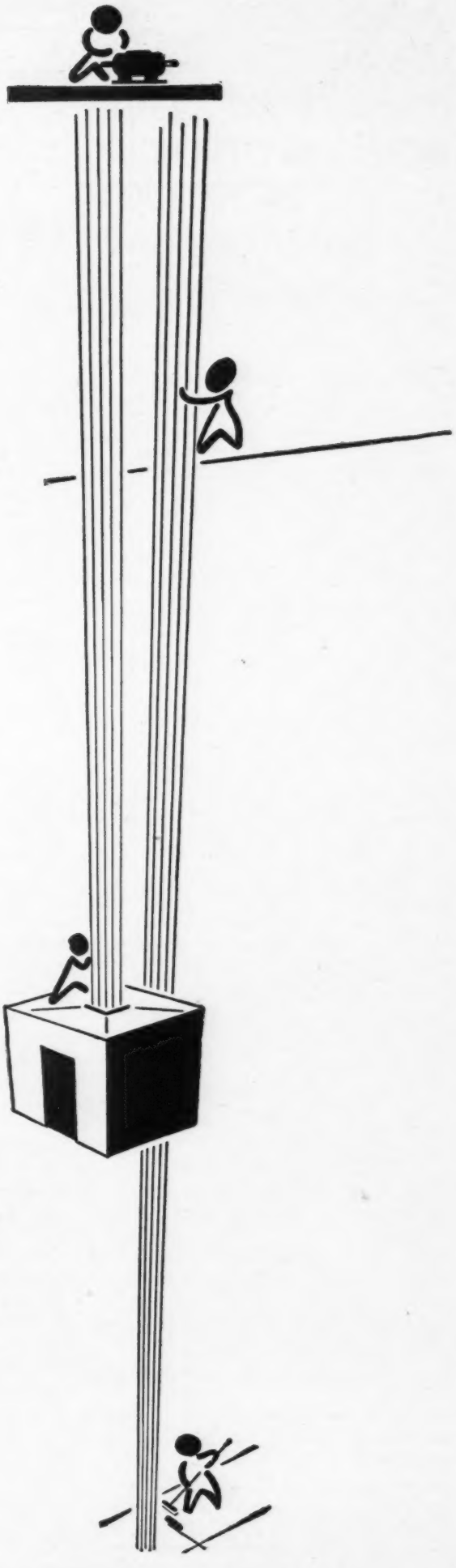
"It will be necessary to import at least one pound of foreign copper to every two pounds of domestic copper this year if we are to maintain the required rate of production on automobiles."

Sosthenes Behn, chairman of the board and president of International Telephone & Telegraph Corp., wrote: "We would be well advised, from a national point of view, to use foreign copper, so as to conserve the domestic



MORE RUSSIAN POWER—Two turbines of interesting design were shipped recently from England to U.S.S.R. These were two-cylinder pass-out turbines which run at 3,000 rpm. and have direct-connected alternators. Inlet conditions are 398 psi., 750 deg. F. Steam passes out at 85 to 115 psi. and is used at the rate of 330,000 lb. per hour. The units are complete with Metrovick alternators and condensing units. Four pass-out units of this capacity have been made for U.S.S.R. for different pass-out conditions

"...so full of a number of things"



OF COURSE elevator maintenance means a lot of little things – like drops of oil and new contacts.

And naturally it means things that aren't so little – like new ropes and re-wound motors.

But it also means a number of things which only the manufacturer of the elevator can be depended upon to provide – like skilled maintenance men, experienced supervisors, a competent engineering staff, reserves of parts, tested lubricants and above all, a manufacturer's interest in the life and service of his product.

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copper for emergency purposes. If we import substantial quantities of copper, we create a potential market for American manufactured goods abroad."

South American mines owned by Americans are now capable of producing from 500,000 to 600,000 tons of copper a year which would be available in this country, Everett Morse, president of the Simplex Wire & Cable Co., pointed out in his letter urging repeal of the excise tax.

Arthur Walsh, executive vice-president of Thomas Edison, Inc., stated that failure to repeal the copper excise tax would reduce production from 30 to 50 percent in all industries using copper. A. R. Hendricks, of the Ocean City Manufacturing Co. of Philadelphia, declared unemployment and possible shutdowns were inevitable unless the excise tax was ended. The Worthington Pump & Machinery Corp. reported its business was threatened by the copper shortage.

H. D. Keresey, president of Anaconda Wire & Cable Co., said in his communication that "the tax is a complete barrier to import. . ." Substitution is out of the question, his letter said, and a production bottleneck is threatened.

"Prompt action with reference to the four-cent a pound excise tax on copper will relieve a situation which could readily become one of the most serious in the country," Mr. Keresey's letter concluded.

An industry-wide committee composed of members of NEMA has already been appointed to study the whole copper situation and to guide any industry action which might be taken. Okonite's president, F. C. Jones, a member of that committee, told the assembled NEMA members at their convention in Chicago on March 5 that "if quick action is not obtained in Washington, we are faced with a 50 percent shortage." At that time he urged each individual member to contact his Congressman to get that action.

•

Production Technique Set Up for Special Castings

Non Ferrous Foundries, Inc., Indianapolis, has installed facilities and perfected manufacturing techniques for the production of special heat treatable copper alloy castings made under a license arrangement with P. R. Mallory Co., Inc.

The line of heat treatable copper castings includes materials ranging from 20-85 percent IACS electrical conductivity, hardness value ranging from 65 Rockwell B to 38 Rockwell C and tensile strength values ranging from 50,000 to 110,000 psi.

U.S. Copper Output Drops in '46; Shipments Down

Production of newly mined copper for 1946 totaled only 650,469 tons, compared with 841,667 tons in 1945 and the war-time peak of 1,194,699 in 1943, according to figures released by the Copper Institute. A slight increase was effected in December, when output of domestic mines was 78,140, against 73,020 in November and a low of 29,280 in April, a strike-bound period.

Refined copper production in December was 77,578 tons against 75,066 the preceding month, and output for the year aggregated 604,071 tons, compared with 843,113 in 1945 and 1,206,871 for the 1943 peak period.

December deliveries of refined copper to consumers in the United States were 148,218 tons, a monthly peak for more than a year and a half and were not far from some of the best war-time months. Deliveries of 1,267,653 tons for all of 1946, however, were the smallest for more than six years.

COPPER STATISTICS

(In tons of 2,000 pounds)

	Production			
U. S. Duty Free Copper	Crude	Refined	Domestic Deliveries	Refined Stocks
1941.....1,016,996	1,065,667	1,545,541	75,546
1942.....1,152,344	1,135,708	1,635,286	65,309
1943.....1,194,699	1,206,871	1,643,677	52,121
1944.....1,056,180	1,098,788	1,636,295	65,780
1945..... 841,667	843,113	1,517,842	76,512
1946..... 650,469	604,071	1,267,653	80,832

•

Westinghouse Appliance Dollar Volume a Record

A dollar volume of business in January and February, 20 percent greater than any two-month period of consumer production in the history of the Westinghouse Electric Appliance Division has been reported by J. H. Ashbaugh, vice-president, who added that the increase not only reflects the higher cost of production but also indicates that steady production has been maintained.

The major limiting factor in production now is materials, and this situation is being seriously aggravated by the current box car shortage which curtails shipments of finished appliances as well as the receipt of raw materials.

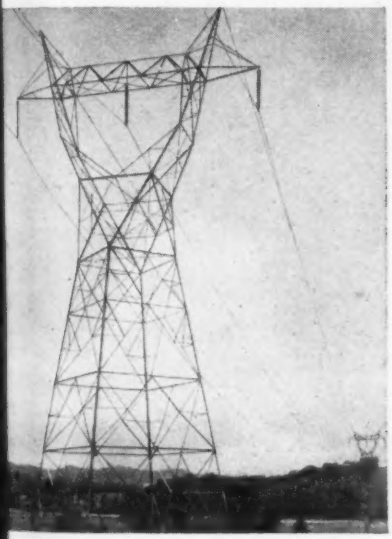
•

Moves Chicago Offices

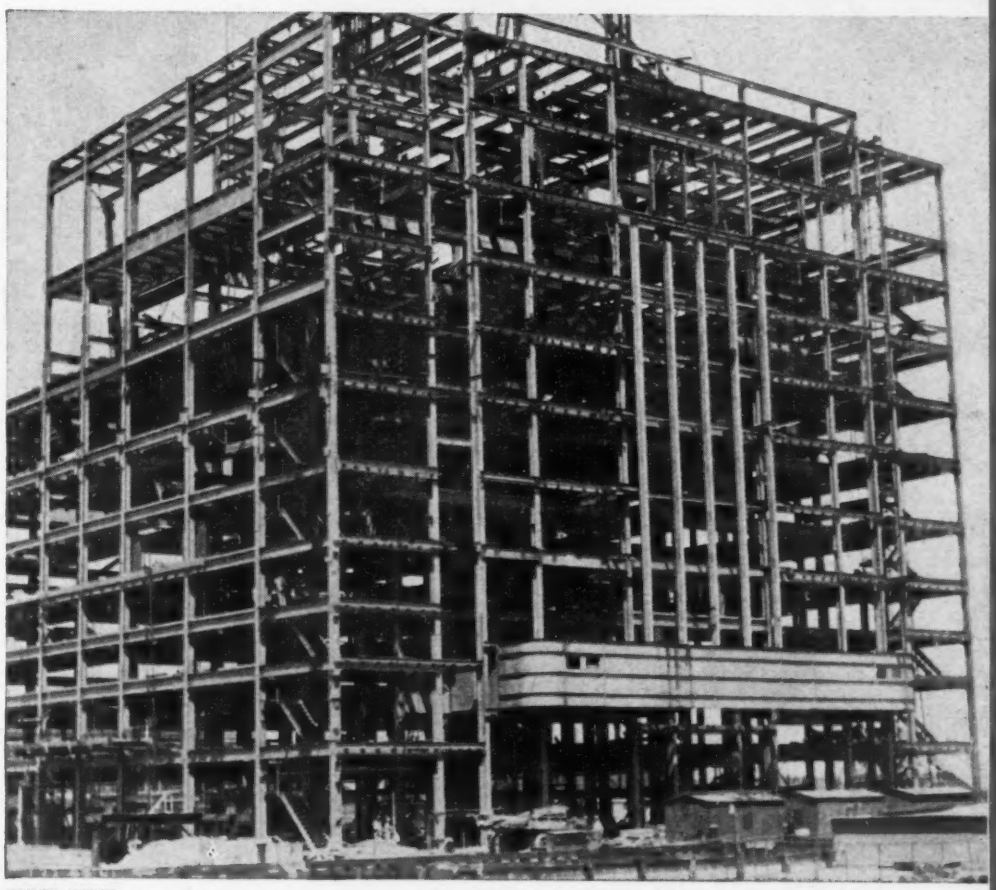
Change of address of the Chicago office of Rollway Bearing Co., Inc., has been announced. Room 3716, Civic Opera Building, 20 North Wacker Drive, Chicago, has been occupied by F. S. Darke and W. C. Schloskey, Rollway representatives in Chicago.

When it comes to power construction let American Bridge **carry the load!**

FOR FASTER, more economical erection of power houses, call on American Bridge. We have the modern equipment and experienced personnel to do the job right. In addition, our facilities for fabricating and erecting power houses, substations and transmission towers enable us to give you—in one "package" — a complete, coordinated service all along the line. On your next job, take advantage of American Bridge Company's unexcelled resources in equipment, in experience, and in technically trained personnel.



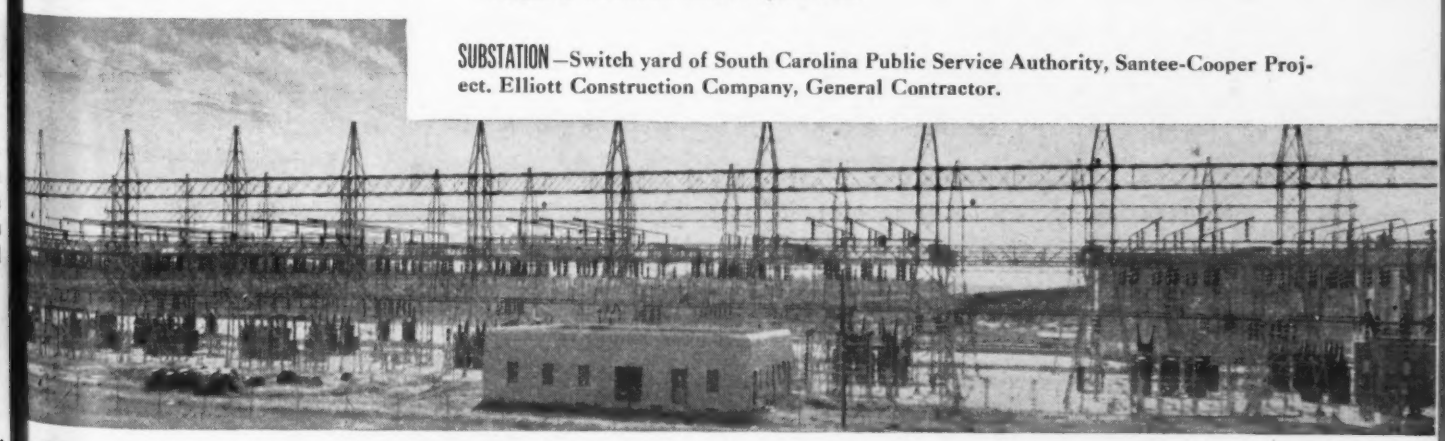
TRANSMISSION TOWER—An American Bridge Company rotated-type single circuit 220 KV suspension tower.



POWER HOUSE—Southwark Power Station of Philadelphia Electric Company. American Bridge Company fabricated and erected the Power House, Maintenance Shop, Boiler House, Electric and Heater Bay, Turbine Room, Switch House, Administration Building, Turbine Supports and Coal Handling Structures.

Weight of structural steel—11,850 tons.

SUBSTATION—Switch yard of South Carolina Public Service Authority, Santee-Cooper Project. Elliott Construction Company, General Contractor.



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"QUIET JUNIOR! Daddy's doing his homework"

Junior's old gent is a busy man.

He has to have plenty of "know-how" to keep on top of his job.

Sometimes it takes home-work to keep abreast of things and right now he's reading this issue of this McGraw-Hill magazine—the one you are holding in your hand.

Obviously, he's not looking for glamour, amusement, or entertainment. *He is strictly on the make for ideas.*

He wants to know what the other fellow is doing — what's new in methods and processes that will help him do a better job.

He's an avid reader of the ad-pages as well as the editorial content. The advertisements along industry's shopping street give him an opportunity to inspect the products and services of America's leading manufacturers — and he examines them with an eye to what they can do for him.

Yes — Junior's old gent is a busy man. But he never misses a trick!

To keep in touch with the parade . . . read the ads.

F-4

Recent Rate Changes

ELOY (ARIZ.) LIGHT & POWER CO. has been ordered by the state Corporation Commission to reduce its power bills for farmers in the Eloy district by $14,000 a year. The order for a slash in rates came after a number of postponements of the hearing on the company's rate structure. The first hearing was scheduled for last November 1. The hearing brought a strong protest from the utility's attorney, who argued that negotiations for the sale of the company to the Trico Electric Cooperative had delayed preparation of briefs. Trico is an organization formed to serve consumers in Pinal, Pima and Santa Cruz counties. The action was one of six involving the Eloy utility. Two of the others are suits in Pinal County superior court, one questioning the validity of the sale of the utility to Trico and the other seeking the Eloy property by condemnation proceedings. The interim tariff set by the corporation commission will be in effect until such time as Eloy reopens the case and is able to prove cuts excessive.

SACRAMENTO (CALIF.) MUNICIPAL UTILITY DISTRICT board of directors has voted to adopt previous rate schedules of the Pacific Gas & Electric Co., the local properties of which the Municipal Utility District took over on January 1. The decision was made with the understanding that as soon as possible action will be taken to cut rates.

LOUISVILLE (KY.) GAS & ELECTRIC CO.'s president, T. B. Wilson, has rejected the city's amended plan for a sliding electricity rate based on the utility's earnings. Mayor E. Leland Taylor said the city will continue with its suit for a $3,400,000 rate reduction which has been pending in Frankfort before the Public Service Commission for some two years. Mr. Wilson advised both Mayor Taylor and Aldermanic President C. Paul Downard that the amended plan fundamentally was very little different from the original plan which was "wholly unacceptable." Mr. Wilson termed the plan "simply a proposal that the city and the company, by agreement, attempt to oust the Public Service Commission from the jurisdiction conferred upon it by the Legislature to regulate utility rates."

•

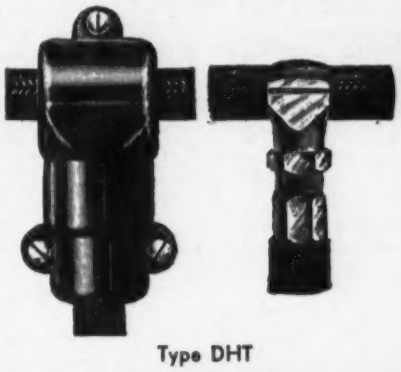
Foreign Orders Placed

Orders for more than $60,000,000 of products, from household appliances to waterwheel generators, were placed during 1946 with the Westinghouse Electric International Co. by customers in some 95 foreign countries.

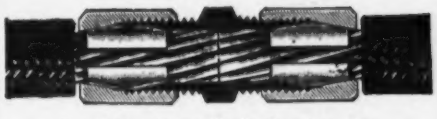
•

Form New Sales Agency

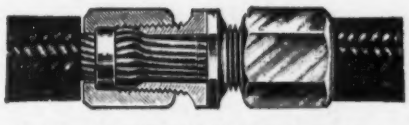
Joralemon, Craig & Co., 112 South 16th St., Philadelphia 2, Pa., announce that they have succeeded to the business formerly conducted by L. D. Joralemon and will continue to act as field representatives for Weston Electrical Instrument Corp., Newark, N. J.; American Transformer Co., also Newark; Western Electro Mechanical Co., Oakland, Calif., and Radio Frequency Laboratories, Inc., Boonton, N. J.



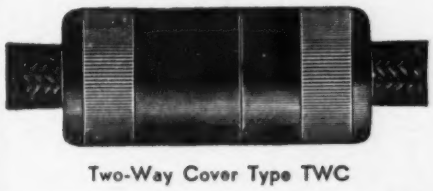
Type DHT



Two-Way Type "A" Construction



Two-Way Type "B" Construction



Two-Way Cover Type TWC

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A two way connector for coupling cables on end. Available in the type "A" or type "B" construction as illustrated. The type "B" construction develops many times the tensile strength of the conventional fitting. For instance with a 500MCM cable the tensile strength is 5,350 lbs. Both connectors are available with insulating covers type TWC to make an insulated joint as illustrated.

Send for literature on the type "B" construction which outlines comparative strengths and cable anchor applications.

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